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Wooden Nose of Pipe Line Pulled Across Burrard Inlet Emerging at South Shore

Water Works Articles In This Issue:

Pulling 1,200 feet of 18-inch Cast Iron Pipe Across Burrard Inlet, Vancouver, B. C.

Reconstruction of the Water Filters at Albany, N. Y.

Recreational Uses of San Diego's Water-Supply Reservoirs

Several Short Articles on Special Water-Supply Problems

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

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FRANK C. WIGHT
Editor

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Bureaucracy

IN *Engineering News-Record*, Aug. 12, there was published an editorial, "Once More the Navy Exonerates Itself." That editorial was a criticism of the Navy Department not only for its gross neglect of ordinary precautions in the storage of explosives at Lake Denmark, N. J., but for the easy designation by a Navy Board of Inquiry of the explosion at that arsenal as an act of God. The editorial has come to the attention of T. Douglas Robinson, acting secretary of the Navy, and Mr. Robinson has addressed a letter to this journal, which passes over without comment the specific criticisms of the editorial but says: "I have read the article to which you refer and consider it grossly unfair, not only to the Navy Department, but to your own country." This sentence is commended to the citizens of the United States as a brilliant example of what bureaucracy does. Mr. Robinson has been a government official for but a few months, but already he takes on all of the airs and trappings of the generation-old bureau head. If one presumes to criticise the Navy Department, forsooth, one becomes a traitor to one's country. If Mr. Robinson is reporting the true spirit of the Navy Department, we can only feel more strongly than ever before that Congress or the President or some one outside of the department had better investigate the Lake Denmark explosion.

Commendable Co-operation

THE campaign for the abolition of cross-connections between city water-supply systems and any and all other sources of supply of possibly dangerous quality is being met with a commendable spirit of co-operation in many quarters. An instance of this is reported in a paper on "Cross-Connections in Chicago," by Arthur E. Gorman, in the *Journal* of the American Water Works Association for June. The local department of public works having prohibited all cross-connections, it got in contact with the chief engineer of the Chicago Board of Fire Underwriters, "whose chief engineer," says Mr. Gorman, "adopted a policy which is not only legally sound, but also has been of material assistance in certain cases where stubborn resistance was anticipated." That policy was to remove insurance rate credit on any illegal cross-connection as soon as notified of the existence of such connections. With such co-operation as this the elimination of deadly cross-connections will be hastened.

Under Water

LAYING pipe under water affords the engineer endless opportunities to exercise his ingenuity. Of scores of submerged pipe laying jobs described in this journal in the last half century the methods of no two have been alike in all details and while the ways used fall into a few general classes there is only a family resemblance between many of the jobs in the same class. Perhaps Vancouver, B. C., has as many submerged water-supply mains as any city in the world. An article in this issue describes the latest of these—about the twentieth thus far laid, with more to come. Not all those put under water are now in use, partly for reasons that have nothing to do with the integrity of the submerged pipe. Mr. Brakenridge's article is notable both for the method it describes and the clearness and fullness of the illustrated description of the block and tackle system employed.

Bad Building Again

IF THE decision of the District of Columbia Court of Appeals against the steel contractor and the architect in the Knickerbocker Theater case (reported two weeks ago, p. 291 and in this issue, p. 386) turns out to be sound law, the movement to improve building procedure by assuring more definite technical control and responsibility in building will receive a serious setback. The judge who decided the Washington case built up an array of precedents to establish his assertion that the contractor is not liable to any third party "after the work has been completed and accepted by the owner of the building." With this assertion he strengthens the hands of those who believe in the doctrine of getting away with it: the doctrine that their skirts are clear if they can manage to finish the job and get the owner to accept it. Not only the contractor, however, but the architect also is exculpated by the amazing judicial findings of the Washington judge. Apparently the architect too is free of responsibility so long as he can get the owner to accept the building—though the owner obviously knows nothing about the strength or sufficiency of the building except what the architect tells him. For a long time the trend in improvement in building practice has been in the direction of making architect and engineer, on the one hand, and contractor on the other, conscientiously answerable for the results of their work. The District of Columbia decision is against this trend, and thus is a backward movement. It is inimical to sound professional practice and sound building.

The Passing Pioneers

ALMOST the last of the pioneers in American railway location passed when William Hood died last week. He was born when there were less than 5,000 miles of railway in the whole United States and when he graduated from Dartmouth, still a lad though he had served two years in the Union Army, the great transcontinental lines were in their swaddling clothes. For more than fifty years their development was a major part of his life, and when he laid down the reins of active service in 1921 he had to his credit the location and the con-

struction of as many miles of mountain and desert railway as any man of his own—or of any other—time. Only the other day a contemporary of his remarked that he was the premier locating engineer of the great railway building era and that his feat of personally laying out the Southern Pacific's line from the coast to El Paso, a location which has stood with only strategic changes for forty years, was the outstanding location feat of the century. The art of railway location and the science of railway building are in the doldrums; the era of their need has passed. Only a few of the pioneers are left. Their successors in the profession of engineering can do no less than to pay them a parting tribute as they leave the scene.

Foolish Publicity Methods

PUBLICITY methods will probably always be varied and mysterious, and subject to many differences of opinion. But there can hardly be much difference of opinion about the bad taste and unwisdom of some publicity efforts in which the steel and the lumber interests respectively have recently indulged. The steel fabricators' organization sent out a news item on steel house construction not long ago, which asserted that "steel houses" (whatever these may be) are much cheaper than ordinary houses and in some cases have cost only half as much. The lumber manufacturers' organization now fights back in the steel-versus-lumber war by sending out a press notice saying that the first steel house built in the United States has proved to be hard and costly to heat—in detail, a one-story five-room building took 10½ tons of coal last winter to heat it, and the occupants were uncomfortably cold at that. Of these two publicity attempts, the first one is obviously misleading, presumably through ignorance or misinformation, while the second one is absurd in every possible respect, and incidentally suppresses the fact that the house in question has its walls composed not of steel but of stucco and plaster, applied to steel members framed very much like the wood studding in ordinary frame houses, many of which have similar stucco and plaster wall sheathing. The engineer, a friend of both steel and lumber, is little likely to be edified by either kind of publicity information; the effect on the citizen in general will be almost as unfavorable; and the net result is that the two publicity items fail to spread information and fail to inspire a liking for steel or lumber.

Town Roads

PUBLIC roads officials are becoming conscious of a town-road situation. An article in this issue outlines the problem and suggests a solution. This article should be read. In Wisconsin, where the writer has had most of his highway engineering experience, appreciation of the important functions of the town road is particularly keen. The new state law—it is barely two years old — providing and allotting highway income, specifically includes the town road and the village street as recipients of tax money in definite amounts. This includes motor vehicle license and gasoline tax money which never previously in the United States has been granted to road administration units smaller than counties. Because it shares in the general road fund is perhaps the reason why township road management has come especially into notice by the state road maintenance engineer. What he has to tell of township road conditions in Wisconsin is not different from the story in other states: It is that the township road supervisor frequently changed, without highway training, without adequate equipment and with little money does a poor job. The article offers centralization as a cure. Substantially it would have town road work done by the county. The argument need not be repeated. The plan has indisputable advantages; the average of town road improvement would probably be higher if the counties directed township expenditure. By the same token county road improvement would average better if state public-roads commissions managed the work. There are many who take the conclusion still further. Perhaps this is a certain way to better town road administration. Is it the only good way? How about the way of Glen Haven the town which the article praises for its accomplishments in local road improvements? It didn't call in the county to do its housekeeping.

Water and the National Future

HERBERT HOOVER has fairly won his reputation as the most forward-looking of our public men. While his colleagues and contemporaries have been indulging in the usual political platitudes, he has been devoting his engineering mind to those economic fundamentals that may not have the historic vote-getting appeal, but which nevertheless mean more to the future of the country than the details of tariff and world courts. Waste and its prevention, organized knowledge of economic trends, reduction of unnecessary parts and styles, the development of a serviceable governmental department out of what had been merely a routine record office, all testify to his sane view of what the country needs. He has now embarked on a new campaign of public education along a course which has been haltingly pursued by engineers for some time, but which needs the commanding direction of one who so completely holds the confidence of the average American.

This new interest that the Secretary is displaying is in the proper development of the waters of the United States. The first indications of this appeared some months ago, but it has been rising in force for some time, culminating in the two or three speeches that Mr. Hoover has made within the last month on a Western tour. These speeches are all directed toward one end, though they are different in tone and somewhat different in detail. The Secretary has recognized the need for a more co-ordinated and sensible development of the water systems of the United States, and he has, as is his custom, developed a finished theory of what should be done in order to make proper progress.

His theme is quite simple. Water is the prime necessity of human life. It enters into many phases of existence. Our drainage systems, as the Secretary calls them—that is, our great rivers and their tributaries—have four important functions. From them can be generated power; on them may be operated freight carriers; waters may be drawn off to irrigate arid lands, and finally they are the sources of the sanitary services of our cities for both water supply and waste disposal. More than that the unrestrained river carries always a potential flood danger which needs probably more consideration than the beneficial uses.

All this is elementary, of course, but when we come to our major drainage systems—the Mississippi, the Columbia, the Colorado, the St. Lawrence—the conflicting demands of these uses and the conflicting control of various governmental units extending over large areas make most complicated the proper development of any system. Shall the water be used for power? Shall it be used for navigation or for irrigation or for domestic supply, or shall it be used for all or some of these, and, if so used, who shall direct its use? Who shall plan how much shall be diverted for each use and who shall exercise control thereof? Is irrigation paramount or is power development? And in either case, has the federal government, the state government, or even the municipality the rights of control? These are questions which are disturbing all through the country, and they are questions which are not being satisfactorily settled.

Nothing so stirs up controversy or so defies settlement as the disposition by use or locality of any given water source. Both our law and practice have failed to meet the modern situation.

Mr. Hoover has a plan for settlement. He believes that there should be enough intelligence in the United States to organize for the future. The areas surrounding our rivers are in many cases in imminent danger of flood. Some way should be found to prevent such floods. Power from flowing water is a demand of the future. Of the 55,000,000 hp. available in this country, less than 11,000,000 has been developed. We could not use the whole 55,000,000 immediately, but we probably can in the next generation. Of the 25,000 miles of inland waterways in this country, 10,000 miles have been modernized, but those that have been modernized are in isolated sections and rarely usable as a system. There are 30,000,000 acres of irrigable lands yet undeveloped, and while it has been only too clearly shown of late that the irrigation is a hazardous occupation, Mr. Hoover is probably right when he says that fifty years from now will see us carefully encouraging and accelerating the agricultural production of the country. To meet these conditions Mr. Hoover proposes, therefore, that we organize commissions for each of the great drainage systems, commissions on which will be represented federal, state, and independent technical members. These commissions would be advisory and judiciary in character. They would not spend money or administer projects or construct anything. But they would consider engineering data, think, plan, devise, advise, co-ordinate, negotiate, and recommend what administrative bodies, either national, state or local, should do the actual work, and upon such recommendations the administrative and executive work would devolve upon single-headed, responsible bodies representing whatever part of our national system seems best for the particular case.

The broad vision that Secretary Hoover displays is encouraging and to be encouraged. It is not necessary to agree completely with him in his forecast of immediate necessities. Indeed, it may seem to many that his vision regarding the demands of irrigation and of navigation is over-optimistic. Irrigation, as a subsidized business, has been a failure. River navigation, as promoted and conducted in the past, is economical only if the charges are carefully distributed to some one other than the carrier or consumer of the goods transported. But both irrigation and waterway navigation have been too much in the hands of the politician and too little in the hands of the engineer and economist. It is the possibility of changing this that makes Mr. Hoover's plan appealing. Its effect would be to take this kind of development for the future out of the hands of political manipulators and put it in the hands of scientific planners—to separate the vision from the execution, to see the problem as a whole even though its doing shall be in minute part.

We seem to be getting along very slowly on the big problems connected with our waterways. The Colorado River continues to flow to the Gulf of California with the prospect of a destructive flood in the Imperial Valley at any time. The St. Lawrence, with its potentialities of navigation and power almost unlimited, remains a political problem. The Mississippi and the Columbia and the Tennessee all are being tackled piecemeal, if at all. If we are going to get anywhere with them, we must look forward to their co-ordinate development, and to do that we must take some bright vision of the future such as Herbert Hoover now is trying to put before his fellow citizens.

Water Purification Advances

WHEN the Albany water filtration plant was put in use over a quarter century ago it marked an epoch in water treatment. England had been using slow sand filters for seventy years but with a very few exceptions they had not been used in America. The Albany plant, with all European experience, the Lawrence experiments of the Massachusetts State Board of Health and the new city plant at Lawrence to profit by, set the standard for slow sand filters in this country. But growth of population, and also of a pollution heavy at the start, combined with advances in the art of water treatment, gradually led to supplementary measures at Albany. Carried out to meet emergencies and always with a new and better supply in prospect, the supplementary measures were somewhat makeshift in character. Two or three years ago the city was wise enough to call on the engineer for the original plant to recondition it and the various additions so they would serve until a new supply can be introduced. How that was done is well told by Allen Hazen on other pages of this issue.

To meet almost unmatched water treatment burdens, especially as regards pollution, Albany now uses double aeration, coagulation, double filtration and chlorination. Coagulation and pre-filtration together are virtually the equivalent of mechanical or rapid filtration, which had been in use a dozen years when the first Albany filters were built, but was still in the development stage, with many doubting its efficiency and many opposed to the use of a coagulant. Since then mechanical filters have been greatly improved in process and structurally. Chlorination has come into wide use. Aeration has been carried forward.

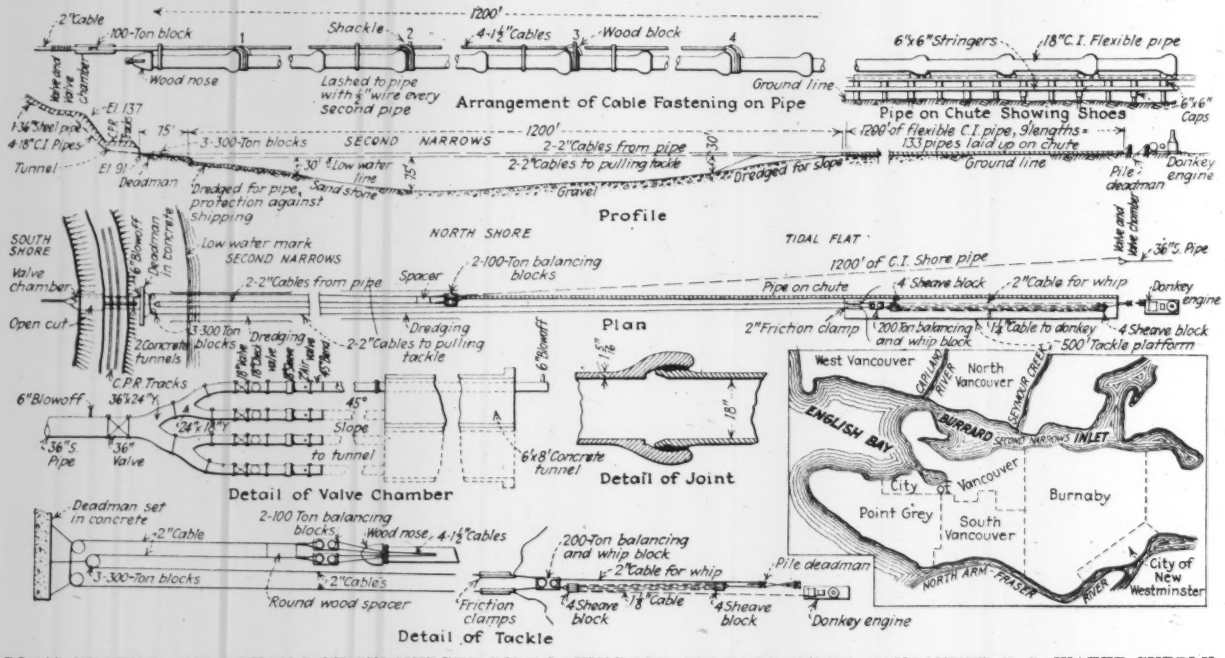
The Albany plant is a notable example of how the engineer combines for the service of man as many forces of nature as may be necessary, in case of emergencies going temporarily into complication and expense that he would gladly avoid—as Mr. Hazen makes clear when he states that a relatively pure gravity supply is now the proper recourse for Albany, as indeed he believes would have been preferable in the late nineties.

Pulling 1,200 Ft. of 18-In. Cast-Iron Pipe Across Burrard Inlet, Vancouver, B. C.

Pipe Assembled on Chute on Tidal Flat and Hauled Across Inlet by Cables Pulled by Donkey Engine Located at Rear End of Pipe—Main Put Into Service Immediately

By C. Brakenridge
City Engineer, Vancouver, B. C.

THE MOST interesting feature in the construction of the third water-supply conduit from Seymour Creek, recently put into commission by the city of Vancouver, B. C., was the crossing of Burrard Inlet at the Second Narrows by the first of four 18-in. flexible-joint cast-iron submerged mains. The pipe for the crossing was put together on a chute and pulled or pushed across by cables and pulleys operated by donkey engines located at the rear end of the pipe and chute, as shown by the accompanying plan, profiles and views. The third conduit extends from an intake on Seymour Creek to Little Mountain reservoir near the center of the Greater Vancouver Water District. It is of $\frac{9}{16}$- to $\frac{5}{8}$-in. steel, has a diameter of 36 in. and a length of about 13 miles. The 18-in. submerged main has a carrying capacity of 9 U. S. m.g.d., as shown by a Venturi meter on the 36-in. conduit.

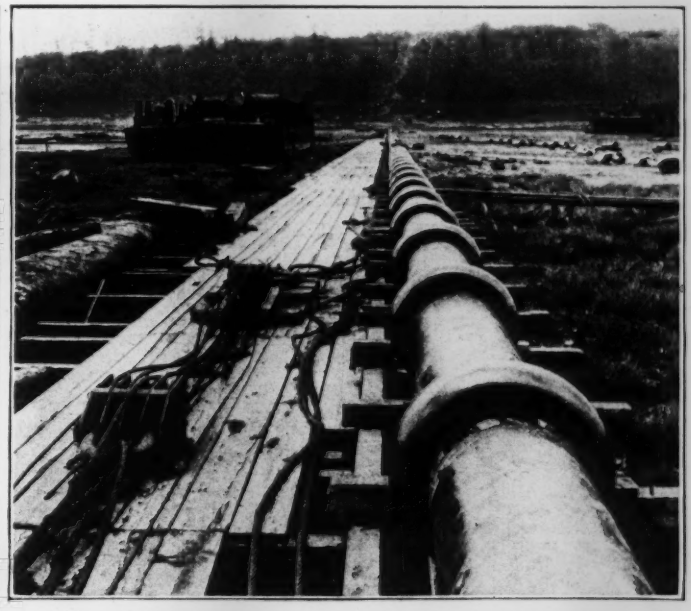


PLAN, PROFILE AND DETAILS OF SUBMERGED PIPE LAYING JOB, BURRARD INLET, VANCOUVER, B. C., WATER SUPPLY
The entire 1,200-ft. of pipe was assembled on shore and hauled across by the donkey engine and cable equipment shown.

The gap to be closed at Burrard Inlet consisted of 1,200 ft. of completely submerged course and 1,200 ft. of tidal flat on the north shore. The range at spring tides is about 14 ft. The tidal flat and the working platform were completely covered at high water; and this, combined with the necessity for guarding against the slightest interruption to navigation, made special planning necessary. The leading and calking of the joints in the assembled pipe could only be carried on after the tide had fallen sufficiently. No pulling could be done during high-water slack; and the rapid currents at ebb and flow, which attain a velocity of seven knots or more at times, reduced the actual period available for pulling to about half an hour at low-water slack. The southern shore is a steep bluff with a very narrow beach at the foot. The Canadian Pacific Ry. tracks run parallel to the shore on a cut and fill at the back of the beach.

In laying twelve earlier lines across the inlet the donkey engine had been placed about half-way up the bluff, which called for overhead tackle platforms across the tracks. This time, the location of the pipe line made it necessary to reverse the order of things, and place the donkey engine on the north shore near the assembled pipe. The pulling cables were led from the forward end of the pipe line across the Narrows, around a set of blocks on the south shore, and back again to the pulling tackle.

The tackle platform was 500 ft. long, and the donkey engine stood at the north end. The donkey was a logging hoisting engine with 12x14-in. cylinders, and a line pull of 35,000 lb. under 175 lb. boiler pressure. The pull was transmitted through a $1\frac{1}{8}$-in. steel cable to the 4-sheave pulling blocks. These were in turn connected, either directly to a 200-ton balancing block, or to a 2-in. whip-line when the doubled power was needed. In the diagram the movable 4-sheave pulley block is shown attached to the whip-line, which is bent around one sheave of the balancing block. When



SUBMERGED WATER MAIN CROSSING AT VANCOUVER

Left—Looking north across Second Narrows from steep southern bluff. Trench in foreground leads to culvert under the C. P. R. tracks. Notch in northern shore line is end of dredged channel. Behind it is tidal flat, with pulling platform at the right of the chute and the assembled pipe. The white patch is the tackle platform with the donkey engine at the north end. The lower end of Seymour Valley is seen in the distance at the back of the wooded terraces of gravel which fringe the northern mountains.

Right—Looking south across tidal flat and Second Narrows to steep southern shore. The tackle platform is seen at the left of the pipe line. The 4-sheave pulling blocks and their 1¼-in. steel cable rest on the platform, the 2-in. whip-line lying between.

using the lower power, the whip-line was taken off and a bridle was led from the movable 4-sheave block and put round the nearer sheave of the balancing block. This block was in turn connected by a short 2-in. cable bent around the second sheave to the two sets of pulling clamps. Each clamp consisted of a pair of grooved steel plates, 6 ft. long, 3 in. thick, and 8 in. wide, held together by fourteen 1⅛-in. bolts. These clamps were taken off and replaced in a fresh position after each section of the pull had been completed. The length of the pull without the whip-line was 400 ft., and with the whip-line 200 ft. A minimum clearance of 4 ft. was maintained between the moving cables.

200-TON BALANCING BLOCK AND PULLING CABLES

Just beyond it are the two friction clamps which grip the ends of the two 2-in. pulling cables, and the short connecting length which equalizes the pull on the cables. The 2-in. whip-line is seen in the foreground passing around the nearer sheave. One end is attached to a deadman, and the other is connected to the movable 4-sheave block. When the double power given by the whip-line is not required, the whip-line is taken off and replaced by a bridle connected directly to the 4-sheave block.

The 2-in. pulling cables led from the pulling clamps on the north shore, across the Narrows to the south shore, around a group of 300-ton single-sheave blocks anchored to a large deadman set in concrete, and back again across the Narrows to two sets of 100-ton balancing blocks, which occupied the bights of two doubled 1½-in. cables that were attached to the pipe line at four gripping points. The first of these grips was taken at the back of the bell on the end of the first pipe length, and the others at intervals of 300 ft., the last 300 ft. acting as a drag to keep the pipe in line. A wooden nose was held in place on the front end by a 1½-in. wire cable which ran inside the entire length of the assembled pipe, enough tension being put on this internal cable by a 2-in. screw and nut to take the pressure off the lead joints while the pipe was being pulled. The nose of the pipe was lashed to shackles, which in turn encircled the attachment cables, thus keeping the nose close to the cables while in motion. The attachment cables were lashed to every alternate pipe-length with ½-in. wire line, which kept all four in place on the top of the pipe while the balancing blocks equalized the pull.

The chute was carried by trestles at 3-ft intervals. The alternate trestles consisted of four 4x4-in. posts, driven to bearing, and capped with 6x6-in. x 16-ft. pieces. This width provides for the placing of a chute on the other side of the tackle platform when pulling

a second length of pipe at a later date. Additional support was given to the structure by trestles resting on mudsills in the interspaces. The two stringers under the chute were of 6x8-in. timbers on edge, placed 2 ft. apart. These were crossed by 6x6-in. bearers 3 ft. apart. The chute was made of 4x16-in. timber on the bottom, and the sides of 2x6-in. stuff. The bells of the pipe rested on shoes, 4x15x24 in., in which recesses 3 in. deep had been cut with an adze. The chute was 1,200 ft. long. On it the pipe was assembled, leaded, and calked, and the cables were attached ready for pulling. The chute was well lubricated with a mixture of soft soap and yellow grease.

LOOKING ALONG ASSEMBLED PIPE SLIGHTLY EAST OF NORTH

The pair of 100-ton balancing blocks and the wooden cable spreader are seen in the foreground. One 2-in. pulling cable is in position, clamped round the nearer sheave of its balancing block; but the cable going to the right-hand block is not yet in position on the other side of the cable spreader. On the top of the pipe-line are the four sections of 1¼-in. attachment cable, two of which are concealed except where they double round the farther sheaves.

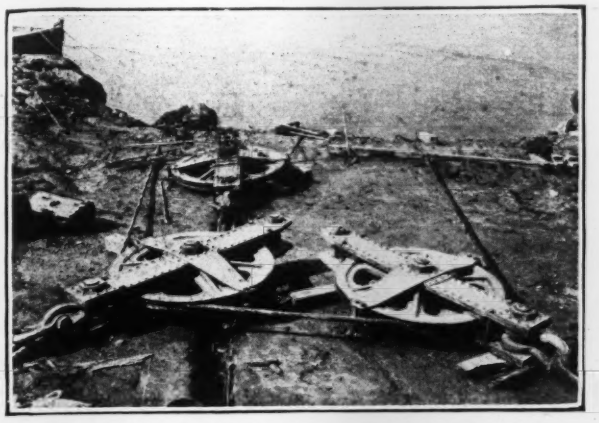
The channel was dredged on the north side to a maximum depth of 30 ft. below low water, diminishing northwards to provide a gradual slope for the pipe in the tidal flat. The bottom was gravel and boulders from the northern high-water mark to the middle of the channel; and the remainder was sandstone with a thin covering of sand. On the south side a channel was blasted and dredged from the subaqueous contour line of 30 ft. below low water southwards to a sufficient depth to insure the complete protection of the pipe by its rock trench.

A rock ledge was encountered at the southern low-water line. This was blasted and dredged to make an easy slope; but the operation reduced the width of beach available for pulling purposes, and increased the difficulty of placing the blocks to advantage. These blocks were three in number, with sheaves 5 ft. in diameter, and were each of 300 tons capacity. One took the inner pulling cable while the other two guided the outer cable around the bight of the inner one.

It was necessary to install the complete system of Y's and valves on both the north and south shores, so that the submerged main when laid could be put into service at once. On the south shore the new submerged main has been continued upwards with 18-in. bell-and-spigot cast-iron pipe through a reinforced-concrete culvert 8 ft. wide by 6 ft. high, under the C. P. R. tracks, and up an open cut at 45-deg. slope to a valve chamber outside the railway right-of-way. The culvert is large enough to take a second line of pipes; and a similar culvert will be built when the third and fourth submerged mains become necessary. The valve chamber contains four 18-in. check valves and four gate valves of the same size, a pair of 18x24-in. cast-iron Y's, a 24x36-in. cast-iron Y, and a 36-in. gate valve on the end of the steel main going to the Little Mountain Reservoir. The arrangements on the north shore are exactly similar, except that the four check valves are omitted, while the line of bell-and-spigot cast-iron pipes across the tidal flat from the valve chamber to the submerged main is much longer.

The pipes of the submerged main have a working length of 9 ft. The spigots are turned to a diameter of 23½ in. The bells are spherical, machined inside and ground to a diameter of 25½ in. The bell openings have a diameter of 23⅞ in. A perfect ball-and-socket joint is formed when the lead is poured, which allows the pipe to swing 14 deg. on either side of the center

line. The shell thickness is 1⅝ in. and the working pressure for which it is designed is 275 lb., which will be nearly reached when the intake is carried up to Seymour Falls. The total weight moved was 300 tons; as the pipe was not kept filled with air during the pulling, there was no deduction in weight except for water displaced by the metal. The pipe was actually in motion a little over an hour; but this was spread over a period of nearly four days.



WOODEN NOSE AND PAIR OF BALANCING BLOCKS EMERGING ON SOUTH SHORE

The wooden spreader was removed by a diver before the final section of the pull was taken. Without this it would not have been possible on the narrow and encumbered beach to raise the end of the pipe-line out of the water. In the foreground are the bights of the pair of 2-in. pulling cables, the three 300-ton blocks with their 5-ft. sheaves, and the connections to the deadman.

The work was done under the direct supervision of the writer, with T. C. Mahon as resident engineer on the Second Narrows Crossing section.

PIPE EMERGING ON SOUTH SHORE

The spreader has been removed, so that the two balancing blocks lie one above the other. In the background are the three 300-ton blocks and the culvert under the C. P. R. tracks.

[*Articles on four of the earlier crossings appeared in "Engineering News," Feb. 2, 1889, p. 90; May 14, 1908, p. 525; April 1, 1909, p. 339; Dec. 30, 1915, p. 1258. From the last-named article it appears that up to the close of 1915, a total of 19 lines of submerged pipe had been laid across the narrows, of which 11 were then in service: at the First Narrows, 11 12-in. and 2 18-in.; at the Second Narrows, 6 18-in. In "Engineering Record," Sept. 6, 1913, p. 263, there is an illustrated description of the block and tackle and cable arrangement used to haul a pipe across the Second Narrows.*—EDITOR.]

Removing Mud-Balls from Filter Sand

BY MARTIN E. FLENTJE
Superintendent of Filtration, Oklahoma City, Okla.

THE presence of a number of mud balls in the beds of several filter units at Oklahoma City, Okla., necessitated the cleaning of the filter sand in some manner. The filters are 2,000,000-gal. units, arranged in two beds, one on either side of a central gullet. They filter a lime-softened water, after carbonization with flue gases. A small section only of each filter is housed under the operating roof, the remainder of the beds being covered by a concrete slab roof, approximately 4½ ft. above the surface of the sand.

The occurrence of mud balls is explained by the fact that sewer trouble caused insufficient washings for a time, and also because the applied water was insufficiently carbonated. This explanation is borne out by the fact that mud balls have not developed in other filter units that were put into service after improvements were made in the carbonating apparatus and after the trouble in the sewer line had been remedied. A partial analysis of the mud balls is: Moisture, 18 per cent; acid soluble, 9.5; ignition loss, 0.4; residue, 72.1 per cent. In size they were ¼ to ½ in. in diameter and from ½ in. to 1 in. long.

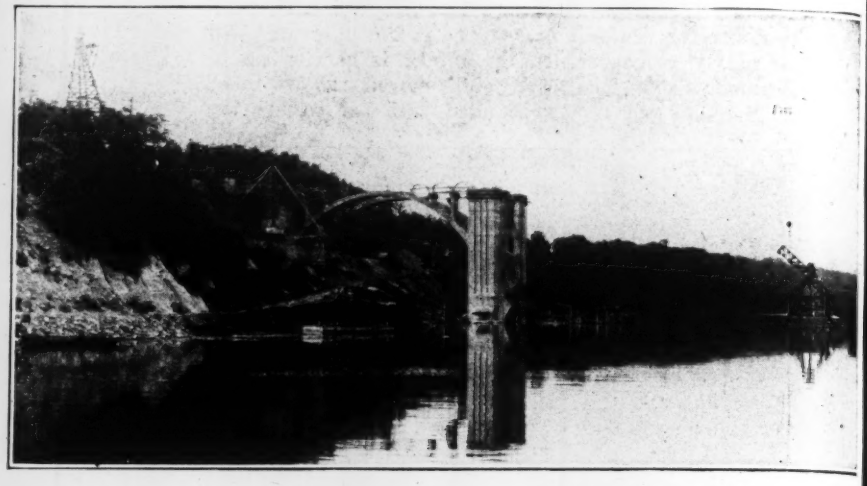
It was proposed to allow the filters to dry thoroughly during the winter, when they were not needed, to below the depth to which the mud balls appeared (about 6 in.). It was hoped that the balls when dry would disintegrate easily, and could then be removed by repeated washings of the filter. However, even after five months drying, the mud balls were so hard that the wash water was unable to break them up. It was decided to put the sand through an ordinary sand jet discharging against the filter wall. This was done in place, the sand being washed and scraped back into place very easily and quickly. The water entered the jet through a 3-in. pipe at 70- to 80-lb. pressure, and was then throttled down to 1 in.

This process completely disintegrated the mud balls. The entire operation was quickly completed, as two men were able to finish a filter in two days. After the filters had been repeatedly washed, they were examined. A fine mud collected on the surface of the sand bed, that could not be washed out. This was removed by scraping, about ⅛ to ¼ in. of sand being removed, the filter being then in condition for service.

The total cost of cleaning, including the cost of water and labor, was approximately $20 per filter.

Omaha Water-Works Erecting New Buildings

The Metropolitan Utilities District, which supplies water, gas and ice to Omaha, Neb., and vicinity, is erecting what will be known as the Utilities Building and also a service building. The Utilities Building is 66 x 136 ft. in plan, with four stories and a basement, and will house all the office activities of the water, gas and ice departments operated by the district. It will be completed early in 1927 at a cost of about $275,000, met by the earnings of the district. A like sum is being expended on a four-story service building, 138 x 172 ft. in plan, which will be completed in December. Besides providing storage space, the service building will house the water and gas meter shops and the municipal garage. Theodore A. Leisen is general manager of the Omaha Metropolitan District.



Inter-City Bridge Across the Mississippi River Between St. Paul and Minneapolis

Six Concrete Arch Bridges at the Twin Cities

Four of the Bridges Being Built—Two Completed—Five Cross the Mississippi River—Two-Rib, Five-Rib, Barrel and Bowstring Arch Designs

FOUR concrete arch bridges under construction in and near the "twin cities," St. Paul and Minneapolis, represent diverse features of design, adapted to special conditions at the respective sites. These structures are: (1) the Robert St. bridge, St. Paul; (2) the inter-city bridge; (3) the Cedar St. bridge, Minneapolis, and (4) the Fort Snelling-Mendota bridge. The first three cross the Mississippi River, while the fourth crosses the wide valley of the Minnesota River. Three of the bridges are being built by contract, but the Cedar St. bridge at Minneapolis is being built by day labor, the bid put in by the city engineer being considerably below the lowest contract bid. Brief particulars of this interesting group of concrete arch bridges are given below and listed in the accompanying table.

Robert St. Bridge, St. Paul—In this city bridge, about 1,100 ft. long between arch abutments and exclusive of concrete approaches, numerous conditions governed the arrangement of spans. The main channel span, 244 ft. in the clear, is of the bowstring type, with two arch ribs having structural steel reinforcement, from which is suspended a steel-frame deck. On the south side, this span is flanked by four arches of 112-ft. clear span, with five ribs each, while on the north are three barrel arches of 95½, 71 and 98-ft. span. The engineers are Toltz, King & Day, Inc.; the Fegles Construction Co. is the contractor.

Inter-City Bridge—This structure, connecting Ford Ave., St. Paul, and 46th Ave., Minneapolis, has five arches of the rib type; three of 300-ft. and two of 139-ft. span. It is in the hands of a commission composed of the state commissioner of highways, the president of the council and the city engineer of Minneapolis, with the mayor and the commissioner of public works at St. Paul. The design was worked out jointly by George M. Shepard, chief engineer of the department of public works, of St. Paul, and N. W. Elsberg, city engineer of Minneapolis; M. S. Grybak, bridge engineer for the city of St. Paul, acted as chief draftsman in preparing the design and is superintendent of the construction work. The contractor is James O. Heyworth, Inc., Chicago.

Cedar St. Bridge, Minneapolis—This city bridge will have seven arch spans of the two-rib type, two with clear spans of 265½ ft. and five of 93 ft. The total length of the river portion will be 1,146 ft., while concrete viaduct approaches will make a total length of 2,921 ft. The bridge was designed by N. W. Elsberg, city engineer, and will be built by the city on the day labor system under his direction, with F. T. Paul as field engineer and superintendent of construction.

Fort Snelling-Mendota Bridge—In this long structure, carrying a state highway across the valley of the Minnesota River, the main feature is its series of twelve ribbed arches, having a clear span of 283 ft. 4 in., with a total length of 4,066 ft. between abutments. Its cost is being met jointly by the state and Hennepin County. The engineers are Walter H. Wheeler and the C. A. P. Turner Co., Associated, of Minneapolis, and the contractor is the Koss Construction Co., Des Moines, Iowa.

Other Arch Bridges—In addition to these four concrete arch bridges now under construction, mention should be made of two older concrete arch city bridges over the Mississippi River at Minneapolis. Most notable of these is the Cappelen bridge at Franklin Ave., with its 400-ft. main arch, flanked on each side by one of 199 ft. and one of 55½ ft., the total length between abutments being 1,032 ft. It has a width of 60 ft., with a 40-ft. roadway, as described in *Engi-*

NEW CONCRETE ARCH BRIDGES AT THE TWIN CITIES

	Robert St. St. Paul	Inter-City	Cedar St. Minneapolis	Ft. Snelling-Mendota
Number of spans	8	5	7	12
Type of spans	Rib, bowstring and barrel	Rib	Rib	Rib
Clear span	(1) 244; (4) 112 (3) smaller	(3) 300 ft. (2) 139 ft.	(2) 265½ (5) 93½	(12) 283 ft. 4 in.
Road above water	70 ft.	100 ft	112 ft.	120 ft.
Length between abutments	1,530 ft.	1,516 ft.	1,146 ft.	4,066 ft.
Width between parapets	76 ft.	63 ft.	56 ft	57 ft.
Estimated cost	$1,800,000	$1,322,984	$1,076,000*	$1,870,000

*Lowest bid.

neering News-Record, Feb. 12, 1920, p. 335, and Jan. 25, 1923, p. 148. The other is the Third Ave. bridge, which has seven arches of 211-ft. span and two of 134-ft., and which is built on a reversed curve in plan on account of foundation conditions. This bridge opened in 1918, was described in *Engineering News*, Dec. 30, 1915, p. 1268. All arches are of the rib type in both these structures, which were designed and built by the late Frederick Cappelen, as city engineer of Minneapolis.

Solve the Township Road Problem by Centralization

Not More Money, but Better Use of Money Required —This Calls for Skilled Direction and Better Equipment

By N. M. Isabella

Maintenance Engineer, Wisconsin Highway Commission, Madison, Wis.

Condensed from an article in "Badger Highways" for July, 1926.

THE local, or town, road is a very necessary link in our highway transportation system. Statistics show that 82 per cent of all raw materials is produced on farms; it is then evident that hauling produce from farm to market is a traffic of magnitude. The load which a farmer can bring to market is regulated to a very large extent by the local road or the feeder to the main highway.

In Wisconsin there are approximately 78,000 miles of rural highways; 10,000 miles of this is on the state trunk-highway system and approximately 11,000 miles comprises the county trunk-highway system. The balance, or 57,000 miles, constitutes the town or local roads. The greater part of the 57,000 miles of town roads is plain earth road, some of which has been graded to a fair cross-section, but a large mileage of which is practically untouched so far as grades, alignment, and structures are concerned. There is no inter-town system. One reason is the lack of centralized authority to carry out the work. Not until there is centralized authority in the building of town roads will there be satisfactory results. If one looks back a few years he can see that the connecting up of centers of population by through highways has been made possible only through centralized authority in highway building.

Local Co-operation—The problem is not one of spending larger sums than are being spent at present to improve the local roads, but is one of getting the most out of the expenditures made. Many towns have seen the advantages of a well maintained surface and realize that the cost of hauling produce over such a surface is much less than the cost of hauling over a poor and uncared-for highway. Quite a number of towns have taken advantage of the experience gained by the counties and the state and have adopted small patrol systems on their town roads. This is the first step toward getting an adequate transportation system in the town.

The ordinary patrol work will suffice under ordinary weather conditions, but where heavy clay soils predominate there is very little that can be done during and immediately after rains. The problem is, therefore, one of placing a surfacing on the clay road so that it will be possible to use motor-driven vehicles at any season. In the case of the sand road the surface may be improved with clay or top soil if gravel, shale, or stone is not available. By this it is not meant that all local roads should be graded to a standard cross-section and provided with high-class drainage structures and surfacing, but they may be provided with a surface over which the farmer's vehicle can make its way. In the majority of cases the present drainage structures, while they are not of ample width, will, with very little expenditure, take care of the drainage and suffice for local road purposes. Those structures which are weakened by age and will not permit the heavier loads must be repaired or reconstructed.

To repeat, the local road is the barrier between the farm and market; if the towns are to better the present conditions the work must be planned well in advance. A definite program should be outlined at least five years ahead and then should be adhered to. The idea must be abandoned of placing all the town funds in one small section of road by building it to a standard of a highway that carries a hundred times the traffic of a local road. The funds should be spent over a longer distance, and the more urgent needs should be taken care of first. The time is coming when the towns will want the county highway authorities to go into their localities and build the roads for them, using the county equipment and forces. In this way the work can be done with greater economy. This arrangement will obviate the necessity of towns purchasing equipment and they will also have the advantage of the experience gained by the county forces in the building of highways. If the money expended by the towns were available for the construction and maintenance of town roads by the county forces, it would go far toward connecting up gaps in the present town road systems.

Wisconsin's Problem—There are 1,270 towns in the state and for each to purchase and equip itself with proper and sufficient machinery to handle all road improvement would take large sums of money. Consider also the lost motion that may and often does occur where the work is only temporary, and the loss in depreciation of machinery which is not properly cared for. Much of the equipment used by the towns is left along the roadside and allowed to deteriorate due to lack of a central shop or storage place. It is true that if the counties were to handle all town road work they would require additional storage and repair shops and more equipment, and they would have to employ more men. However, the additional expense would be more than offset by the results obtained under centralized control.

Under the new Wisconsin highway law, every mile of town road which is not on the county or state highway systems is entitled to receive $25 per year. In some towns this does not mean a very large sum, but in others it runs up to two and three thousand dollars. In many cases the towns are requesting that the expenditure of these funds be made by the county highway forces. This is a wise plan and it is believed that more towns should avail themselves of this privilege. The result will be more miles of road for the expenditure.

I have in mind the town of Glen Haven, Grant County, which established a definite program a few years ago to surface the most important roads in the town, thus connecting the farms with the villages and railroads, and making it possible for uninterrupted traffic during all seasons. This town set out with a definite idea and has practically completed the plan outlined several years ago. There are several other towns that have done this, and if one were to ask residents if they would sell their road systems for what they paid for them, plus a good interest charge on the investment, and go back to the old system, they would be unanimous in voting to retain their improved highways. The roads built have more than paid for themselves, and the business men, farmers, bankers, and all others concerned are in better financial condition today than they were before the roads were built.

Considerable progress has been made on state and county highways. Much more remains to be done to take adequate care of the ever-increasing traffic. The gradual improvement of these systems is practically assured by the present highway laws, and by a public sentiment that demands a continuance of construction and maintenance. More attention must now be directed to the solution of the local or town road problem.

Tests on Concrete Piles in Sea Water Undertaken by Navy

Methods Used in Making and Suspending 35 Test Piles Under Pier at Portsmouth Navy Yard —Examination at 6-Month Intervals

EARLY in the spring of 1924 the Bureau of Yards and Docks, U. S. Navy Department, decided to carry out a series of tests of concrete in sea water, in order to add to what little information is available at the present time regarding both the chemical and mechanical erosive effects of sea water on concrete and especially on reinforced-concrete piles.

The preliminary outlines of the plans of the Bureau of Yards and Docks were submitted to a number of cement and concrete authorities, both individuals and agencies, throughout the country requesting recommendations or suggestions as to the manner in which these tests should be carried out. All of these data so received were worked down into a definite plan, outlined below.

In the first place, tests were planned in the nature of an extension of the so-called Aberthaw tests, which were made in 1909 by the Aberthaw Construction Co., of Boston, on 24 reinforced-concrete pile specimens suspended under one of the piers of the U. S. Navy Yard in Boston. Oil and débris in Boston harbor coated these concrete specimens to such an extent that it has been felt by some that the true erosive effects of sea water on these piles were not experienced. Mainly for this reason these current tests have been transferred from Boston to the Navy Yard at Portsmouth, N. H., where there is considerably less oil and débris floating on the surface. The accompanying table lists the 35 concrete pile specimens that were manufactured and gives the pertinent information on each. It will be noted that a large variety of mixes and slumps were used as well as a number of different surface treatments and admixtures. It is hoped that the tests will show the relative effects of sea water on concrete made from high alumina and portland cements. Some of the high alumina piles were placed 24 and 48 hr. after pouring. For most of the others 9 months to a year elapsed between pouring and placing.

The concreting forms were similar to those used for the Aberthaw tests. They were laid horizontally with the top face open and substantially braced. Four ¾-in. deformed, round reinforcing rods were placed at the corners and bound together by five ¼-in. stirrups. The bars for suspending the specimens were made of ⅞-in. round steel, about 8 ft. long with a circular eye at the top and bent over 3 in. at the lower end for an anchor. The flat bar hook as shown in Fig. 1 was attached to this eye for fastening the piles to the pier. A 2-in. pipe 8 ft. long and coated on the exterior with paraffin was placed in the form as near the center of the specimen as possible. This pipe was later withdrawn by melting the paraffin with steam blown into the pipe. The resulting hole in the pile is left for the purpose of observing infiltration of sea water into the concrete. A short section of 3-in. pipe was set into each pile about 4 in. at the top of this hole and covered with a copper cap to prevent any water washing into the hole from the top.

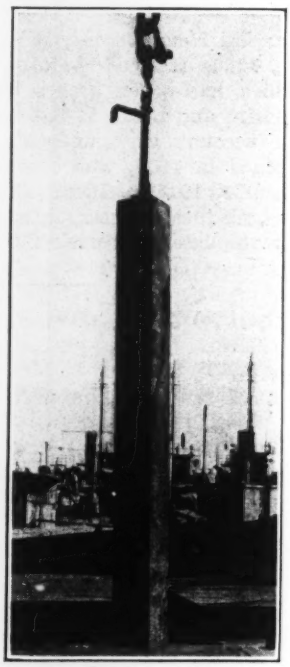


FIG. 1—TYPE OF PILE USED BY NAVY IN PORTSMOUTH TESTS

A complete report has been made by Commander R. M. Warfield (C.E.C.), U.S.N., to Rear Admiral L. E. Gregory (C.E.C.), U.S.N., chief of the Bureau of Yards and Docks, Navy Department, on the manufacturing and placing of these concrete pile specimens, together with details and results of all tests undertaken during their manufacture. The report contains chemical, physical and lithological tests on all materials used in manufacture. The sand, known commercially as Plum Island sand, is a clean river sand used in the Navy Yard for all concrete and mortar work. It is clean and sharp, but of a rather uniform size and has a fineness modulus of 3.09. The crushed stone was taken from a small stone quarry on the reservation and crushed until practically all of it passed through a ¾-in. screen. It has a fineness modulus of 7.09. The gravel was obtained from Topsfield, Mass., and was apparently of very good quality. It had a per cent of wear of 5.0.

An analysis showing the following results was made of the sea water taken near the pier where the speci-

mens have been suspended. The sample was obtained at half tide elevation.

	P.P.M.
Total solids	32,600
Organic and volatile	200
Fixed solids	32,400
Silica	trace
Iron and aluminum oxides	trace
Calcium oxide	400
Magnesium oxide	2,000
Sodium	9,600
Potassium	400
Sulphate radical (SO_3)	2,000
Chlorine	17,600

Equipment and Method of Test—All mixing was done by hand, and the mixing water was kept in a large tank wagon so that the temperature would be approximately the same as air temperature. Slump tests were made with a standard slump cone 8 in. in diameter at the bottom, 4 in. at the top, and 12 in. high. The flow table was the standard apparatus for comparing the flow numbers obtained with the various slump tests. Caliper measurements were made on the compression test cylinders to determine shrinkage or expansion. The compression test cylinders were cast in standard 6x12-in. molds. Concrete cubes 6x6x6 in. for salt water accelerated tests were cast in wooden forms.

With the portland cement specimens three test cylinders were made for each mix and all crushed at the age of 30 days and the average strength taken. With the French high alumina and American high alumina cements, cylinders were manufactured and crushed at ages of 24 hr., 48 hr., 7 days, 30 days, and one year. The usual methods of pouring the molds and smoothing off the surfaces were used. Cylinders were crushed at the testing laboratories of the New Hampshire highway department, Concord.

The cubes made for the accelerated test were cured for 30 days, then marked and placed in a tank of sea water. They were kept in the water approximately 12 hr. and then removed and allowed to dry for 12 hr. This alternate wetting and drying procedure has been carried on for each cube since 30 days after its manufacture. As the water has evaporated, additional sea water has been added, and consequently the concentration has been increased very materially. The object of these particular tests is to determine, if possible, whether or not the disintegrating effect of the concentrated sea water would be accelerated by alternate periods of immersing and drying. Up to the present time no apparent disintegrating effect has been found.

The spot picked for the location of suspension of the specimens was a section of the Southery pier on the northeastern side of the Navy Yard. A section of decking was removed and new 12x12 beams were laid transversely of the pier across the existing stringers and the piles hung from these, as shown in Fig. 2. The hangers were designed so that they would be fairly permanent but at the same time could be easily handled in the moving of specimens for examination. All exposed metal work was thoroughly red leaded and then covered with several coats of tarvia to protect it from corrosion.

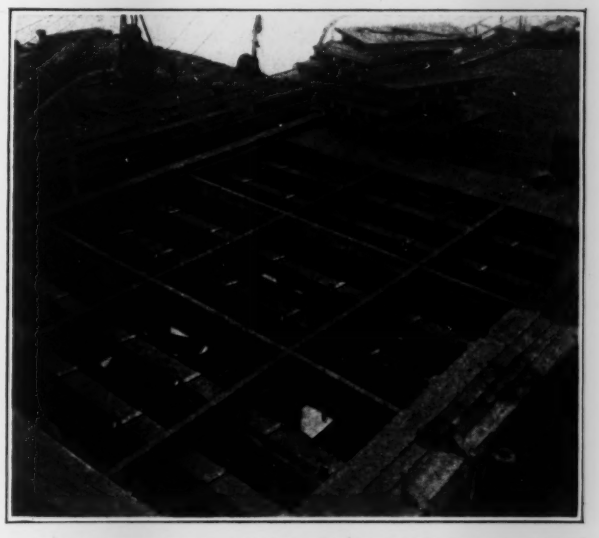


FIG. 2—TEST PILE ARRANGEMENT UNDER PIER AT PORTSMOUTH NAVY YARD

Although there is very little oil or débris floating on the water, it was decided to take the special precaution of protecting the surface of the piles from any that might be present. A solid timber bulkhead extending to a depth of at least 6 ft. below lowest water was constructed. This allows free circulation in and about the specimens, opportunity for thawing, freezing and ice action, and at the same time prevents any floating material on the surface from coming in contact with the specimen.

Photographs were made during various periods of the manufacture of the specimens and it is planned to use photographs to a great extent in showing the chronological effect on the piles as the tests continue. Photographs of all four faces of each pile will be used. It is planned to make periodical inspection of the piles approximately every six months.

DESCRIPTION OF PILES UNDERGOING TEST AT PORTSMOUTH NAVY YARD

Pile	Mix	Cement	Slump, In.
1	1/1/2	Portland	1
2	1/1/2	"	3
3	1/1/2	"	6
4	1/1/2	"	3½
5	1/1½/3	"	'
6	1/1½/3	"	3½
7	1/1½/3	"	6
8	1/1½/3	"	3½
9	1/2/4	"	None
10	1/2/4	"	3
11	1/2/4	"	6
12	1/2/4	"	7
13	1/3/6	"	5½
14	1/1½/3	"	5½
	Two brush coats hot tarvia 4 day before placing .		
15	1/1½/3	Portland	6
	Brush coats hot wax tailings 4 days before placing.		
16	1/1½/3	Portland	6
	Two brush coats cold asphalt solution "Hydro-proof" 4 days before placing.		
17	1/2/4	Portland	½
	Soaked in melted sulphur at 250-340 deg. F. for 1½ hr.		
18	1/2½/4	Portland	6
	165 lb. trass equiv. to approx. 33 lb. per bag of cement.		
19	1/3/6	Portland	None
	Soaked in melted sulphur at 250-340 deg. F. for 1½ hr.		
20	1/3/6	Portland	None
	Soaked in hot asphalt at about 450 deg. F. for 8 hr.		
21	1/1/2	French Fondu (alumina)	6
22	1/1½/3	"	5½
23	1/2/4	"	6
24	1/3/6	"	None
25	1/1/2	Lumnite (alumina)	5½
26	1/1½/3	"	6
27	1/2/4	"	6
28	1/3/6	"	5½
29	1/1.72/3.17	Portland	2½
30	1/2/4	"	6½
31	1/1/2	Lumnite (alumina)	6½
32	1/1½/3	"	6
33	1/2/4	"	7
34	1/2/4	Portland	6
	Used 23½ lb. Celite equiv. to 4/7/10 lb. per bag of cement.		
35	1/1/2	"	3½
	Used 2 qt. saturated solution of calcium chloride per bag of cement.		

NOTE:—Piles all used ¾-in. stone except 29, 30 and 35, which used Topsfield gravel, maximum size 1½ in.

International Air Exposition to Be In Paris

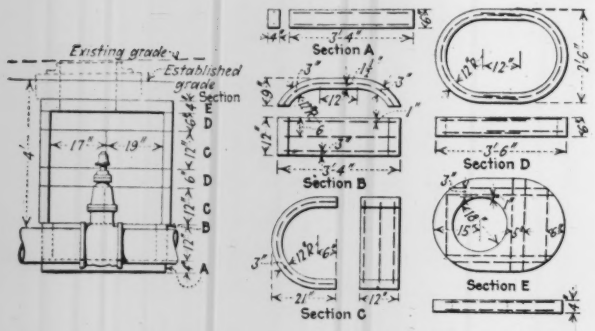
The tenth International Aeronautical Exposition will be held at the Grand Palais, in Paris, from Dec. 3 to 10, 1926. The exposition will be under the auspices of the French Chambre Syndicale des Industries Aeronautiques.

Sectional Concrete Roadway Valve Boxes For Baltimore Water-Works

By V. Bernard Siems
Water Engineer, Baltimore, Md.

Some time ago the Baltimore Bureau of Water adopted concrete vaults for valves instead of cast-iron roadway boxes, primarily for the purpose of minimizing the disturbance of improved paving and of making the valves easily accessible for inspection and repairs. To facilitate installation, especially where traffic was congested, precast sectional concrete vaults were developed.

At first these were made for us under contract at a cost of about $2.75 each, but we had much breakage in shipping, as they were manufactured outside of the city, and we were also handicapped by slow deliveries. We therefore undertook to manufacture the vaults ourselves, utilizing our men who handle stock at district yards, and who perforce are not engaged continuously in the loading of trucks. We believed that we could



PRECAST SECTIONAL REINFORCED-CONCRETE VALVE BOXES, BALTIMORE WATER WORKS
For 6-, 8- and 10-in. valves; slightly larger for larger sizes.

manufacture the vaults at a lower price than we were paying for them under contract. So successful were our first trials that we now manufacture all of the concrete vaults used on the distribution system. During 1925, 12,751 pieces, or approximately 1,275 complete vaults, were made at a cost of $1.52 each. Ten may be said to be the standard number of pieces, but the number varies with the depth of the water main and with the size of the valves, 10 in. being the dividing line as to size.

The detailed cost of the blocks in the early part of 1925 was:

Labor	$0.582	
Material	0.573	
Machinery—electric motor	0.021	
		$1.176
Use of tools (5 per cent) and accompanying labor		0.029
Interest and depreciation, insurance, water consumed, taxes (5 per cent)		0.059
Miscellaneous and contingencies, (10 per cent)		0.118
Total		$1.382
Overhead, (10 per cent)		.138
Total cost		$1.520

We have two plants, one employing five men at our Central District yard, where a gasoline mixer is used, the other employing eight men at our Northern District yard, where an electric mixer is used. In each plant one man operates the mixer engine and supervises the mixing; the other men wheel, pour, tamp, cut steel, and do whatever other work is necessary. Sand and gravel are placed close to the mixer to save unnecessary hauling. From the mixer the concrete is carried on wheels to steel forms, which have been standardized for this work. The electric mixer has been found to be very superior to the gasoline mixer because of fewer repairs, lower power cost and longer life, and we propose to combine the two plants at the Northern District yard, where the electric mixer is used.

Vaults are being placed over all valves on water mains, large services and fire hydrant branches, as installed, or over existing valves when occasion requires work upon them, and the results have been to facilitate valve inspection and maintenance and to reduce the expensive restoration of improved paving.

Adjustable Leg on Trestle Aids Pipe Lowering on Side Hill

In laying a new 26-in. steel pipe line for the Marin Municipal Water District in California it was necessary to support the pipe above the trench during welding, and later to lower considerable lengths of the line simultaneously into the trench. This could not readily be done by the ordinary tripod nor even by a pair of trestles because much of the line was on very steep side hill.

To meet these conditions, a type of trestle was built expressly for this work in which one side, always placed

LOWERING PIPE WITH AID OF SIDEHILL TRESTLE

on the uphill edge of the trench, consisted of an A-frame of fixed height and the other side was a single 3x8-in. upright through which holes were bored at 8-in. intervals so that at any desired level a pin could be thrust through both upright and crossbar.

With this arrangement a trestle such as that shown in the accompanying illustration could be quickly adapted to the slope of the side hill by making the downhill leg as much longer than the other as might be necessary. With a cable sling around the pipe and a threaded rod to effect the lowering, this proved to be a safe and convenient means of supporting the line until it was safely placed in the trench.

The work is under contract to Brown Brothers Welding Co., San Francisco.

One of a Series of Articles on the Details of Design and Layout of Different Types of Industrial Buildings

Steel-Frame Shop for Machine-Tool Manufacture

Two Main Bays with Powerful Cranes, Supplemented by Lateral Bays with Light Cranes—Heavy Concrete Mat Under Machines—Wood and Concrete Floors—Lighting and Heating

A TYPICAL example of machine-shop design for commercial production of heavy machinery is the new plant of the G. A. Gray Co., at Cincinnati, Ohio, manufacturers of metal planers. As most of the parts handled are bulky and heavy, including castings up to 25 tons in weight and 40 ft. in length, and as heavy machinery is required for finishing them, all work is done on the first or ground floor. In similar shops there is only the machine shop and an office building, the castings being made at the old foundry in the city and transported by rail or motor trucks. Later, a new foundry will be built beyond the machine shop, and the runways of the shop cranes will extend across the yard into the foundry, so that castings can be handled directly to the machine tools. An exterior view of one end of the shop, with office building in front, is shown

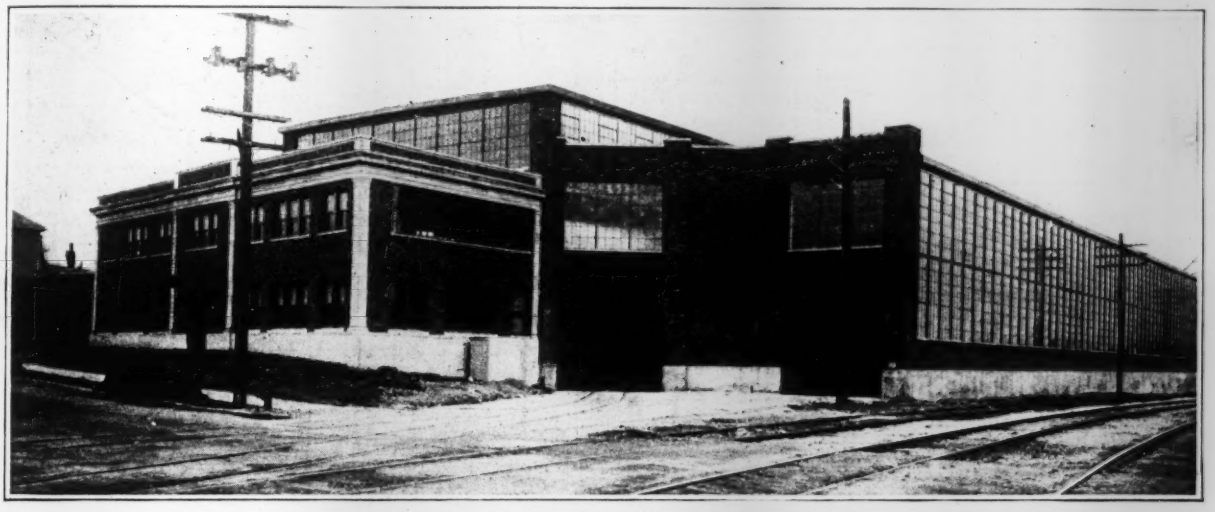


FIG. 1—MACHINE-TOOL FACTORY OF G. A. GRAY CO.
Corner of main bay of machine shop beveled for two track entrances. Side bay shows at left of office building.

where both heavy and light machine work is done, the lighter tools are often arranged on a gallery or mezzanine floor.

This plant, occupying a site of 6½ acres in Evanston, an industrial suburb only 4½ miles from the business center, replaces an old plant in the congested manufacturing district of the city. It is on elevated ground, with a ravine at the rear which provides for convenient disposal of refuse from the future foundry. At present

FIG. 2—INTERIOR OF MACHINE SHOP
Main bay with 20-ton traveling cranes. Parallel side bay at right. On the left are lower bays at right angles with main bay.

in Fig. 1, while an interior view of the main shop is given in Fig. 2.

The shop layout is so arranged that castings delivered at the rear end are moved forward by the cranes to the various drilling, boring and planing machines in the main bays and then to the assembly floor at the front end, convenient for loading onto railway cars or motor trucks. The south or transverse bays are largely for the lighter class of work and for storage. The shop force averages 150 men.

In general, the shop building is rectangular, covering a floor space practically 420x210 ft., except that there is a jog in the rear end, while one front corner is beveled for the entrance of a diagonal railroad track. This arrangement is shown by the plan, Fig. 3. The shop floor is almost entirely unobstructed, the only partitioned spaces on the main area being a first-aid room or hospital, about 20 ft. square, and a toilet and locker room 20x53 ft. At the northwest corner, however, a portion is enclosed for the boiler room, the forge or heat-treatment room, and the substation room for the electrical power equipment. All these partitions are of tile or brick.

Adjacent to one end of the shop and fronting on the street is an office building about 80x30 ft., with two stories, but designed to carry two additional stories when required. This building is of concrete with brick

facing. Its upper floor and roof are of concrete slab and joist construction. After the floor slab was mopped with pitch it was covered with ¾-in. planking on which is the finished maple floor. General offices are arranged on the first floor, with engineering and production offices and drafting room on the second floor. The superintendent's office is at the front end of the shop, being thus adjacent to the main offices and having a view over the greater portion of the shop.

General Design—The layout of the shop building and the structural arrangement are shown by the plan and sections, Figs. 3 and 4. It will be seen that the main bay is 420x60 ft., with a height of 32 ft. 4 in. to the roof trusses and a clear headroom of 23 ft. 6 in. under the hoisting hooks of the traveling cranes. Along the north side is a 50-ft. bay of the same length, with a height of 26 ft. to the trusses and a headroom of 17 ft. under the crane hooks.

On the south side are eight bays at right angles to the main bay, with a length of 100 ft. These bays are 20 ft. and 40 ft. in width, with interior heights alternately 13 and 21 ft. (see Fig. 3). Thus the higher bays form monitors providing additional light and ventilation, while the lofty main bay also forms a monitor, fitted with glazed sash and ventilating panels. Under the local conditions, this monitor roof arrangement was considered to give better light and ventilation than a saw-tooth roof, while on the southern portion a roof of the latter type would have been blanketed by the higher main roof.

Along the north side of the plant is the Cincinnati, Lebanon & Northern division of the Pennsylvania R.R. System, from which three spur tracks lead into the shop. Two of these enter the front end, at the erecting floor, for convenience in loading by means of the shop cranes heavy material for shipment. The third track enters at the rear, for delivering castings and other materials. These stub tracks are depressed so that the floors of cars will be level with the shop floor. The pits and approaches are paved with bituminous composition level with the tops of the rails, so that heavy motor trucks also can be run into the pits to be loaded or unloaded under the large cranes. Along the south side of the shop is a 20 ft. driveway for trucks, paved partly with concrete and partly with cinders.

Foundations and Floors—Precast 50-ft. concrete piles with concrete footings form the foundations, the footings being designed for a soil loading of 6,000 lb. per square foot on the gravel formation. Since the parts to be machined are of great weight and require to be finished with extreme accuracy by massive machine tools, it is important to have rigid and substantial foundations for these tools. One end of the building is on filled ground, however, with rock at a depth of some 30 ft.,

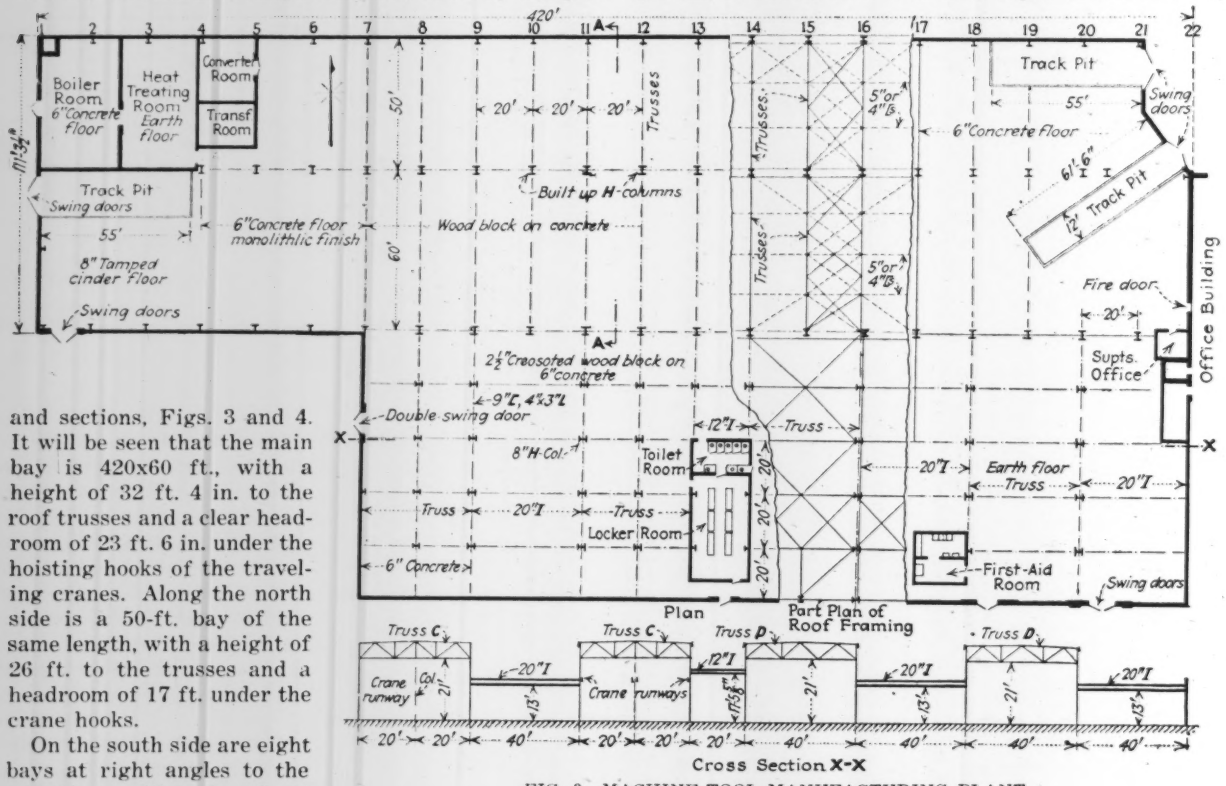


FIG. 3—MACHINE-TOOL MANUFACTURING PLANT
Plan of machine shop and cross-section through row of lateral bays.

so that individual machine foundations carried to rock would have been too expensive. The plan adopted was to cover the area of the main shop devoted to heavy planer work with a reinforced-concrete floor slab or mat 12 in. thick. This mat is made exceptionally rigid by two layers of steel reinforcement, near the top and bottom respectively, each layer having rods in both directions. On this slab is a paving of 2½-in. creosoted wood blocks, forming a floor which is comfortable for the workmen and reduces the noise of shop trucking.

In other parts of the building there is a 6-in. concrete floor slab reinforced with wire-mesh and given a hard float finish to form a dense surface that will resist wear. In the boiler room and electrical room, the 6-in. slab is carried by reinforced-concrete girders of 16-ft. 4-in. span, with intermediate footings, in order to provide for the heavy loads. The forge room has an earth floor, while one portion of the shop assigned for the storage of rough castings is paved with 8-in. of tamped cinders.

Steel Structural Design—For the main and north bays, which are parallel, there are three rows of columns spaced uniformly 20 ft. c. to c., with transverse roof trusses framed between their tops and with longi-

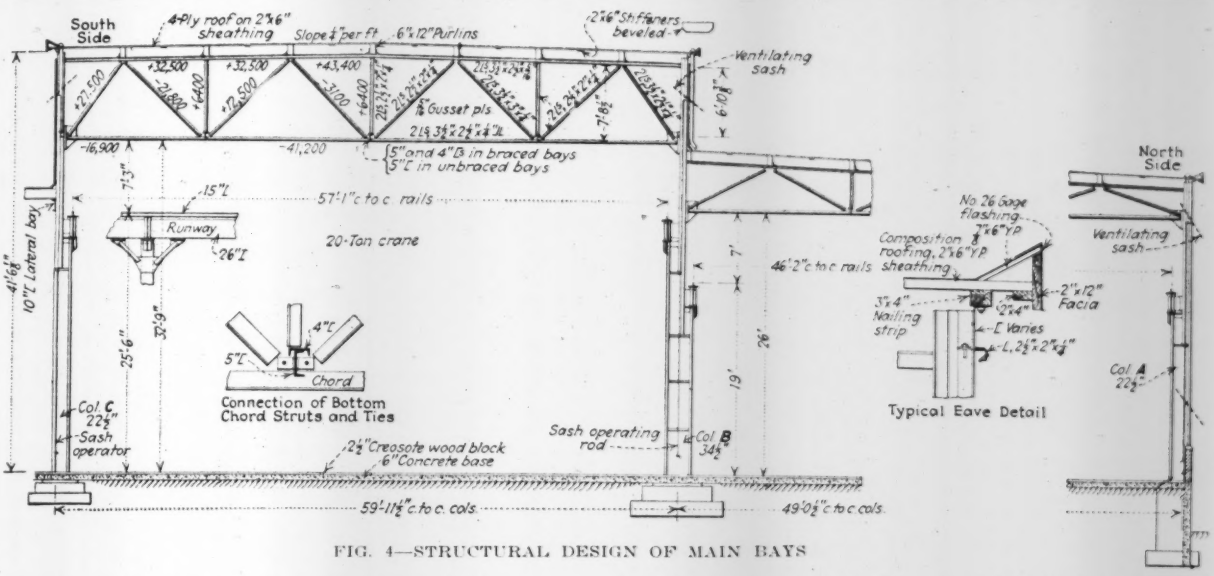


FIG. 4—STRUCTURAL DESIGN OF MAIN BAYS

tudinal struts between the columns of the two outer rows. All these columns are of built-up I-section, reinforced under the crane runways with channels on the flanges, as shown in Figs. 4 and 5. Thus in the central row, where the columns carry two runway girders, each column has a 34-in. web plate up to the first and lighter (15-ton) crane, a 22-in. plate to the second and heavier (20-ton) crane and then a 10-in. web plate to the top, this top portion carrying only the roof load. All these webs are of ⅜-in. plate. In the lowest section, the flange on the heavier side has two 4x3-in. angles and a 12-in. channel, while the opposite flange, under the 15-ton crane, has two angles 3½x3 and a 9-in. channel. Above the runways is the 10-in. plate with four flange angles 4x3 in. In the two outer rows, each column has its inner flange under the crane runway composed of two 3½x3-in. angles and a 9-in. channel on the 22-in. web plate. The outer flange for full height and the inner flange above the runway consist of two 4x3-in. angles on the 10-in. web plate.

The 26-in. I-beam runway girders have their webs attached to the upper part of the columns by diaphragm, while longitudinal stability is given by knee-brace connections. For lateral rigidity an inverted 15-in. channel is laid along the top of the I-beam runway and to this the 60-lb. crane rail, of A.S.C.E. section, is secured by bolts. Sway bracing in vertical planes is fitted between the trusses, together with longitudinal horizontal bracing, while there is the usual transverse diagonal bracing between six pairs of the trusses.

Two 20-ton electric traveling cranes with 5-ton auxiliary hoists are provided in the main bay. Each end is carried by two wheels with 10½-ft. wheelbase and 34,500-lb. wheel loads. In the north bay there are two similar cranes of 15-ton capacity, having 3-ton auxiliary hoists and wheel loads of 27,300 lb. Job cranes of 1-ton capacity are fitted to some of the columns of the main bay. The general handling of light materials and supplies in the shops is done by electric lift trucks.

In the south bays, at right angles to the others, the columns are 8-in. H-beams, with roof framing of trusses and 20-in. I-beams in the high and low bays respectively, as shown by the section in Fig. 3. Some of the high bays have a clear span of 40 ft., but these have no traveling cranes. Others are subdivided by a central row of columns under the 40-ft. trusses, and have a 3-ton or 5-ton crane in each 20-ft. section. For the cranes, the runway girders are supported by having their webs framed against brackets on the columns. To facilitate the handling of material, these runways extend into the main bay, so as to place loads within reach of the larger cranes.

Walls, Roof and Windows—Above a brick base 5 ft. high, the walls are largely of metal sash and glass, the

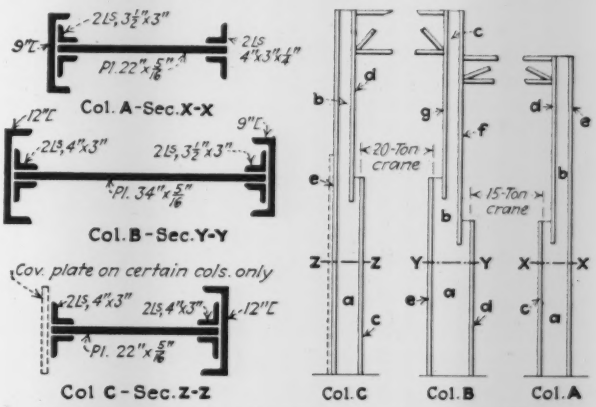


FIG. 5—BUILT-UP COLUMNS FOR MACHINE SHOP

Column *A:* *(a)* 22-in. plate; *(b)* 10-in. plate; *(c)* 9-in. channel and 2 angles 3½x3x¼-in.; *(d)* 2 angles 4x3x¼-in. *(e)* 2 angles 4x3x¼-in.

Column *B:* (a) 34-in. plate; (b) 22-in.; (c) 10-in., all ⅜-in. plates; *(d)* 9-in. channel and 2 angles 3½x3x¼-in.; *(e)* 12-in. channel and 2 angles 4x3x¼-in.; *(f)* and *(g)*, each 2 angles 4x3x¼-in.

Column *C:* *(a)* 22-in. plate; *(b)* 10-in.; *(c)* 12-in. channel and 2 angles 4x3x¼-in.; *(d)* 2 angles 4x3 in.; *(e)* 2 angles 4x3 in. and in certain columns a coverplate 12x¼-in., 26 ft. long.

glazed area being about 65 per cent of the wall area and representing 40 per cent of the floor area. Hammered factory glass is used, except for clear glass in the three lower rows. Steel sash is used also for the sides of the monitor roofs. All this steel sash has hinged panels for ventilation, arranged along the upper and lower part of the walls and in the sides of the monitors. These hinged panels are operated in sections from the ground by means of rods with hand-wheels and gear. Wooden swinging doors are used for the track entrances and the

shop doorways. For the interior finish, all brick work and the roof sheathing is painted white, while the structural steel and steel sash are a dark green.

Four-ply built-up composition roofing is used over the shop, laid on 2-in. plank sheathing which is spiked to 6x12-in. wood purlins placed across the trusses and beams. Similar composition roofing for the office building is laid on the concrete slab which will be the future third floor.

Heat, Light and Power Equipment—For winter heating, two boilers supply steam to a number of unit heaters through which air is forced by motor-driven fans. The air is drawn in at the base and discharged in a horizontal direction at a height of 8 ft. above the floor. This arrangement eliminates the use of unsightly air ducts. The heating plant is designed to maintain a temperature of 65 deg. F. in the shop, while direct radiation maintains 70 deg. in the offices and toilet rooms when the exterior temperature is at zero. For electric lighting, the direct system is used, the main bay having lamps of 500-watts placed 32 ft. above the floor and spaced 20x30 ft. In the 50-ft. bay, similar lamps are 26 ft. from the floor and spaced 20x25 ft. Other parts of the shop have lamps of 150 and 200 watts with closer spacing to give a more diffused light.

Alternating current from a transmission line is delivered through a conduit to the substation room, where it is stepped down to 220 volts and 110 volts for machine motors and converted to direct current for cranes and variable-speed motors. Compressed air for pneumatic tools is furnished at 85-lb. pressure in the main pipes by a motor-driven compressor. Water supply taken from a city main under 125-lb. pressure is distributed to numerous coolers and drinking fountains. It is delivered also to a 50,000-gal. tank, on a steel tower, serving a number of outdoor hydrants and a sprinkler system which extends throughout the shop and offices.

Design and Construction—Under the supervision of August Marx, vice-president and general manager of the G. A. Gray Co., this shop plant was designed by F. E. Cardullo and H. W. Hunt, engineers of the company, in conjunction with the engineers of the Austin Co., Cleveland, Ohio. This latter company had the general contract, covering foundations, buildings, heating, lighting, plumbing, air and gas piping, electric equipment, sprinkler system and railway tracks.

Anaconda Fights Goiter with Sodium Iodide

Sodium iodide as a preventive of simple goiter was added to the water supply of Anaconda, Mont., in April and October, 1925, and again in the spring of 1926. The dosage for periods of 14 days is at the rate of 0.664 lb. per m.g., or 0.0003 gram per gallon. At $4.75 per lb., f.o.b. Anaconda, the annual cost is $600 or 5c. per capita. Recently, stated H. M. Johnson in a brief paper read before the Montana Section, A.W.W.A., April 17 (*Journal* A.W.W.A., August, 1926) the school authorities contracted for a supply of chocolate coated iodine tablets, to be supplied to school children, with parents' consent, 15 days each in the fall and the spring. The plan is to give out 30 tablets a year, each containing 10 mg. or $\frac{1}{6}$ grain of iodide. The tablets cost $275 per 100,000 and it is estimated that they will be used by 2,000 children. Their distribution will be under the care of the local health authorities.

Bridge-Building in Pennsylvania a Century Ago

Stone Bridge and Timber Bridge Still Surviving Were Built on Petition—Curious Cost Items

By Harry K. Ellis
Chester County Engineer, Phoenixville, Pa.

CHESTER County contains a number of bridges built about 100 years ago, and still in service. Documents relating to the original construction of some of these bridges throw interesting light on the conditions of bridge construction around 1800. The following notes refer to the oldest of these bridges.

Cope's Bridge—The east branch of Brandywine Creek, in East Bradford township, is crossed by a three-span stone arch bridge which was built in 1807. It is still in use, but is in poor condition at present and its rebuilding within the next year is urgently desirable. From the records it appears to have succeeded a timber bridge. The following application explains its origin.

> To the respectful Judges of the Court of General Quarter Sessions to be held at West Chester for the County of Chester February Term 1804.
>
> The petition of the Subscribers, Inhabitants of the County Aforesaid, Respectfully Sheweth—That the Wooden Bridge over the East Branch of Brandywine Creek on the new State Road in East Bradford Township is going fast to decay and will soon be dangerous for heavy loaded Waggons to pass over, that said Bridge was first erected in the Year 1789 and about Six years ago had all the upper works made new, and now the whole is again nearly gone to decay, or at least so much so, that it is generally judged it must the Ensuing Summer be newly built, and at various times temporary repairs have been made and every few years there must be additional expense to keep it in repair.
>
> Your petitioners therefore conceive it will be vastly more advantageous to the County and travelers to have a permanent Stone Arched Bridge erected, on a well established foundation, and well built of good materials which may last a long time and want little or no repairs, the Stone in the present Bridge are on the Spot, and great quantities of good Stone within a few rods that are offered Gratis to the Public to Supply what may be wanting.
>
> The great increase of traveling on the New State road aforesaid will always warrant the necessity of such a Bridge on so leading a road and over so great a Stream and when once erected permanently will never cost the County anything of consequence hereafter and the Wooden Bridge has been almost a continual expense every few years.
>
> Your petitioners therefore hope the Court will appoint a Jury to view the same and see whether it is not advantageous to remove the decayed Wooden Bridge and to erect a permanent Stone Arched Bridge in its stead.
>
> Which favor shall be gratefully remembered . . .

Thus the original wooden bridge lasted in good condition only about nine years, required extensive repairs at various times, and in fifteen years was in need of complete replacement. This rapid deterioration is surprising. Other wooden bridges, built not long after this period, have attained long life. The oldest covered wooden bridges in Chester County of whose age I am certain were built in 1832; two bridges built in that year are still standing, in an excellent state of preservation, as are also several built during the following ten years. It is believed probable, moreover, that another surviving wooden bridge, known as Marshall's bridge, dates back as far as 1808.

Marshall's Bridge—Fig. 2 shows Marshall's bridge as it appears today. Its earliest known history goes back to 1795, when the following petition and report of the Grand Jury of the county were made:

To the Grand Jury, the Commissioners and the Judges of the Court for the County of Chester, convened at West Chester, August Term 1795.

The Petition of the Subscribers respectfully sheweth—That it appears, from our own knowledge, or upon good Testimony, that it is now about Twenty-eight years, since a bridge suitable for the passing of carriages etc. was erected at the expense of a few neighbouring inhabitants, over the West Branch of Brandywine Creek, near to Humphrey Marshall's Mill—That the Bridge continued in Public use for several years, and especially during the time the American Army lay at Valley Forge, when by their Waggons passing from the head of the Elk Cr. with Corn, it was considerably used and much injured, so that after a time it became impassable for Carriages, but remained as a foot Bridge till about Four year since, when it was thoroughly repaired, at the considerable expense of a few Persons, aided by a trifling subscription. Since that time its public usefulness is pretty well known, being on a road of considerable use from the South West part of the County to West Chester, but by the late freshets it has been thrown entirely down, broken in pieces, and part carried away.—

Now taking into view the distance between Worth's Bridge and the Forks of Brandywine, the number of Inhabitants that may have indispensable occasion to

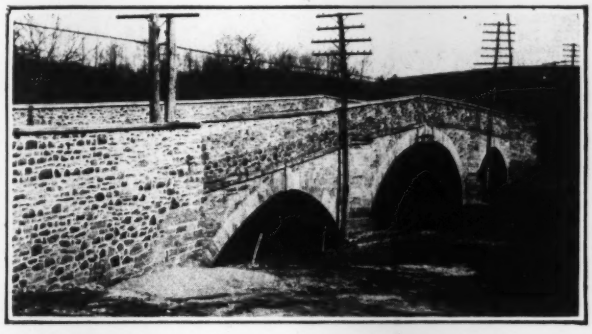


FIG. 1—COPE'S BRIDGE, BUILT IN 1807
Crosses east branch of Brandywine Creek in Chester County, Pa. Now in poor condition and likely to be rebuilt soon.

cross, when the fording is attended with difficulty, with danger, and oftentimes becomes utterly impracticable, and therefore the great inconvenience of not having a Suitable Bridge within S^{d} distance, must we are perswaded point out the necessity for such a Bridge.—We also conceive that for general use, and Situation of Ground the above mentioned place must claim a decided preference for the erection of S^{d} Bridge.

We therefore request, that you may be pleased, deliberately to consider, whether the Public exigence does not require a Public Bridge, or at least however, Whether a few Persons, who have generously maintained, an useful Public Bridge so many years, are not entitled, in Reason and Justice, to a generous assistance with Public Money, for the rebuilding of S^{d} Bridge, and act therein as to you seems just.

Granted That a sum of money not exceeding Two hundred dollars be used at the discretion of the Commissioners in such manner as they may think proper in repairing and building S^{d} Bridge.

SAMUEL CUNNINGHAM,
Aug. 19th, 1795 Foreman.

Some years later, it appears, the bridge was washed out and it became necessary to build a new one. A petition was therefore presented to the Court of General Quarter Sessions in 1807 as follows:

To the Honorable Bird Wilson Esqr. President & his associates, Judges of the Court of General Quarter Sessions of the peace, for the County of Chester, February Term, 1807—

The Petition of divers Inhabitants of Said County, Respectfully Sheweth:—

That a bridge, for the passing of Carriages etc., over the West branch of Brandywine Creek, near Marshall's Mill, for many years past, hath been erected and maintained; primarily by private, but latterly by public expense: That the Bridge last erected by County Charge, was swept away by the unequalled flood of 1805: That the County Commissioners, fearing the popular clamour, and feeling a weakness of power; have declined to rebuild the same: and that altho' your honours were pleased to grant a View, who reported in favor of rebuilding; yet thro' inattention to the letter of the law we find

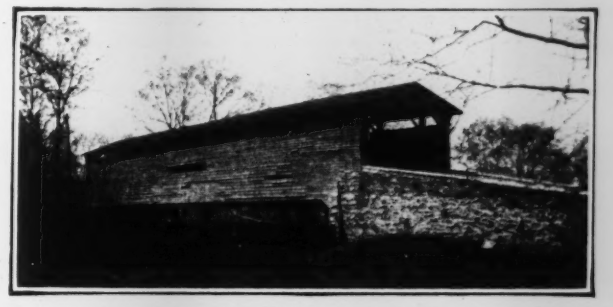


FIG. 2—TIMBER BRIDGE PROBABLY BUILT IN 1808 KNOWN AS MARSHALL'S BRIDGE

the object yet unattained: Therefore from a knowledge of the difficulties and inconveniences, to which not only the neighborhood, but distant travellers are Subjected for want of a Bridge at said place, your Petitioners pray that the Court may be pleased to grant a View to judge of the necessity of Building a Bridge for the passing of Carriages over the West Branch of Brandywine Creek near Marshall's Mill: and your Petitioners will ever pray etc.

The Grand Jury agree that the bridge in question shall be built, and that the County furnish the sum of Four Hundred Dollars for building the same to be paid at the end of one year, from and after the entire completion thereof, agreeably to the proposals of the Petitioners, etc.

It is probable that a new bridge was accordingly built in 1808. No information seems to be obtainable, written or by word of mouth, as to the date of construction of the present bridge (Fig. 2), and it seems probable that the bridge is that of 1808. It is unquestionably very old, as shown among other things by the fact that the bolts used in its construction are hand wrought, which is characteristic of the bridges of that time.

Bridge Costs and Cost Accounting—Going back to a time forty years prior to the period just discussed, there is a very interesting bill for the construction of a bridge in the records of the Chester County Court as follows:

John Falk his Acct. of Chichester Bridge.

315.88 Perches at 14/6 per Perch	£229	0s.	3d.
44 Days Work at the Foundations at 4/0	08	16s.	0d.
5½ Gallons and 1 Pint Rum for the Laborours			
Paid for the Draught of the Bridge			
Between 5 and 6 Perches of the Work washed down in the Flood			
August 28th, 1765	£237	16s.	3d.
Errors excepted per John Foulk			
2 5 perches addition to the wing wall@14/6 perch	003	12s.	6d.
	£241	08s.	9d.
Received in part@Sundry times	190	00s.	0d.
Ballance	£051	08s.	9d.

Settled October the First 1765.

It seems that one of the necessary items of the construction was rum for the laborers, and incidentally also a "draught of the bridge."

Reconstruction of the Albany Water Filters

Slow Sand Plant Built in 1897-99 and Later Supplemented by Coagulation and Pre-Filtration Overhauled —Coagulating Basin, Double Filtration and Booster Pumps Added

BY ALLEN HAZEN
Of Hazen & Whipple, Civil Engineers, New York City

TWENTY-SEVEN years ago a slow sand filtration plant was built by the city of Albany, N. Y., to treat one of the most badly polluted water supplies then in existence. To meet both increasing pollution and consumption, pre-filters were added and other changes made as time went on. The writer, who was engineer for the original plant, was called on in 1923 to bring the old and new filters and accessories as nearly up-to-date as appeared feasible in view of the fact that a new gravity supply was in prospect, but could not be available for some years to come. The recent work, completed in December,, 1925, was designed to meet increased pollution of the raw water and higher standards of quality. Its main elements were a new coagulation basin in place of a makeshift; reconstructing the pre-filters; new aerators in advance of the coagulation basin and between the pre-filters and the slow sand filters; new sand washers and sand storage bins; the partial inspection and repair of the 48-in. steel conduit from the filters to the high-lift pumping station; and booster pumps, primarily to maintain an excess of outward pressure in the conduit during floods and secondarily to increase the capacity of the conduit when needed. A general plan and profile of the reconstructed plant is shown by Fig. 1.

From 1813 to 1873, Albany was supplied with water by gravity from upland sources, some of which were continued in use or held in reserve until recently. In 1873, a pumping station and intake to the Hudson River were installed in the heart of the city. In 1894-96 there was a move for a new gravity supply, which came to nothing. In 1899, the slow sand filters were put in use, water for them being taken from the "back channel" of the Hudson, two miles above the old intake. (See paper by the writer, Am. Soc. C. E., Vol. 43, p. 244, 1900; also staff articles, *Engineering News*, 1898-I, pp. 91 and 121 and II, p. 254.) About nine years later the intake was extended to the main channel of the river, coagulation prior to sedimentation introduced, and pre-filters installed to treat the settled waer before it went

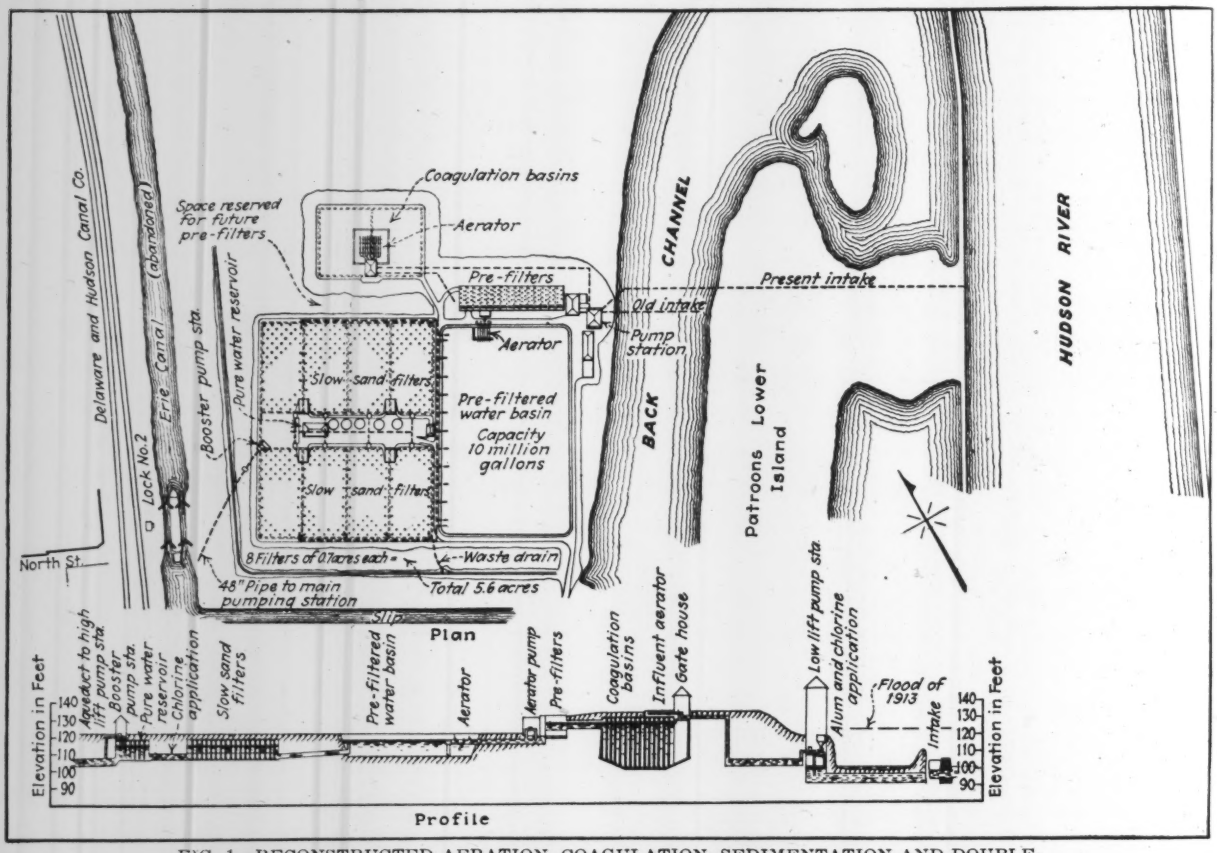


FIG. 1—RECONSTRUCTED AERATION, COAGULATION, SEDIMENTATION AND DOUBLE-FILTRATION PLANT AT ALBANY

The original aeration, sedimentation and slow sand filtration plant was gradually converted into a double-filtration plant, with coagulation and rapid filtration preceding slow sand filtration. By reconditioning and additions, including double aeration, the double-filtration plant has been brought as nearly up-to-date as is feasible.

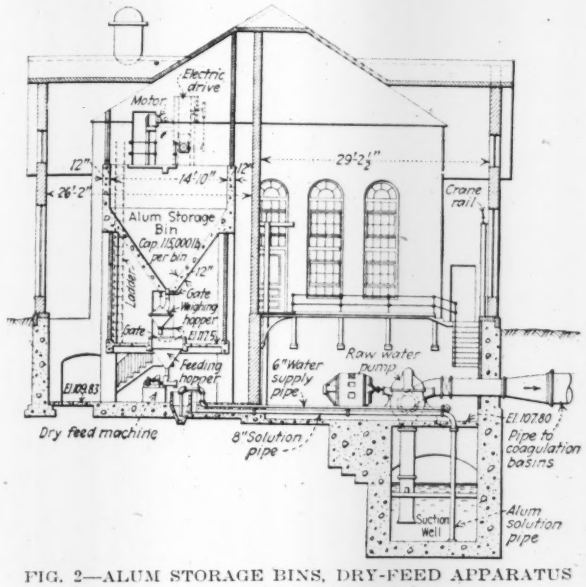


FIG. 2—ALUM STORAGE BINS, DRY-FEED APPARATUS AND RAW-WATER PUMP

There are two bins of 115,000-lb. capacity each, three feeding hoppers of 2,700-lb. capacity each and three solution tanks, the latter with pipe connections discharging at the bottom of the suction well

to the slow sand filters. Aeration of the water just before its discharge into the sedimentation basin was discontinued. Coagulation was used intermittently at first, then more frequently and at last continuously. Chlorination with hypochlorite of lime was begun in 1909, to be replaced in 1916 by liquid chlorine. (For a paper on the first twenty years' operation, by George E. Willcomb, supervising chemist, see *Proc.* A. W. W. A., Vol. X, p. 97, 1923; and for an earlier summary of changes and results, *Engineering News-Record*, Sept. 25, 1919, p. 604, followed by "The Albany Water-Works a Hundred Years and More Ago.")

When the writer undertook a reconstruction of the treatment plant in 1923 he believed, as he did in 1897, and does now, that an unpolluted gravity supply from upland sources is best for Albany. The pollution of the present source has doubled since 1899. Very few American cities take water from sources so badly polluted. On the catchment area of 8,240 sq.mi. there was a population of 780,000 in 1920, of whom 554,000 lived in places of 2,500 and over. The sewage from some of these places is treated but most of it is not. Raw sewage from 118,000 people goes into the river within a few miles above the water intake. There is also a heavy pollution from industrial wastes. Even with the most complete purification it is undesirable to use such water.

The Problem—The writer's task was to provide means for making the water as safe as possible until a new supply, then in contemplation and recently authorized, could be provided. The recent operation of the plant had been unsatisfactory. The old settling reservoir had not been built for use as a coagulation basin. It was not baffled, and being shallow and open was stirred to the

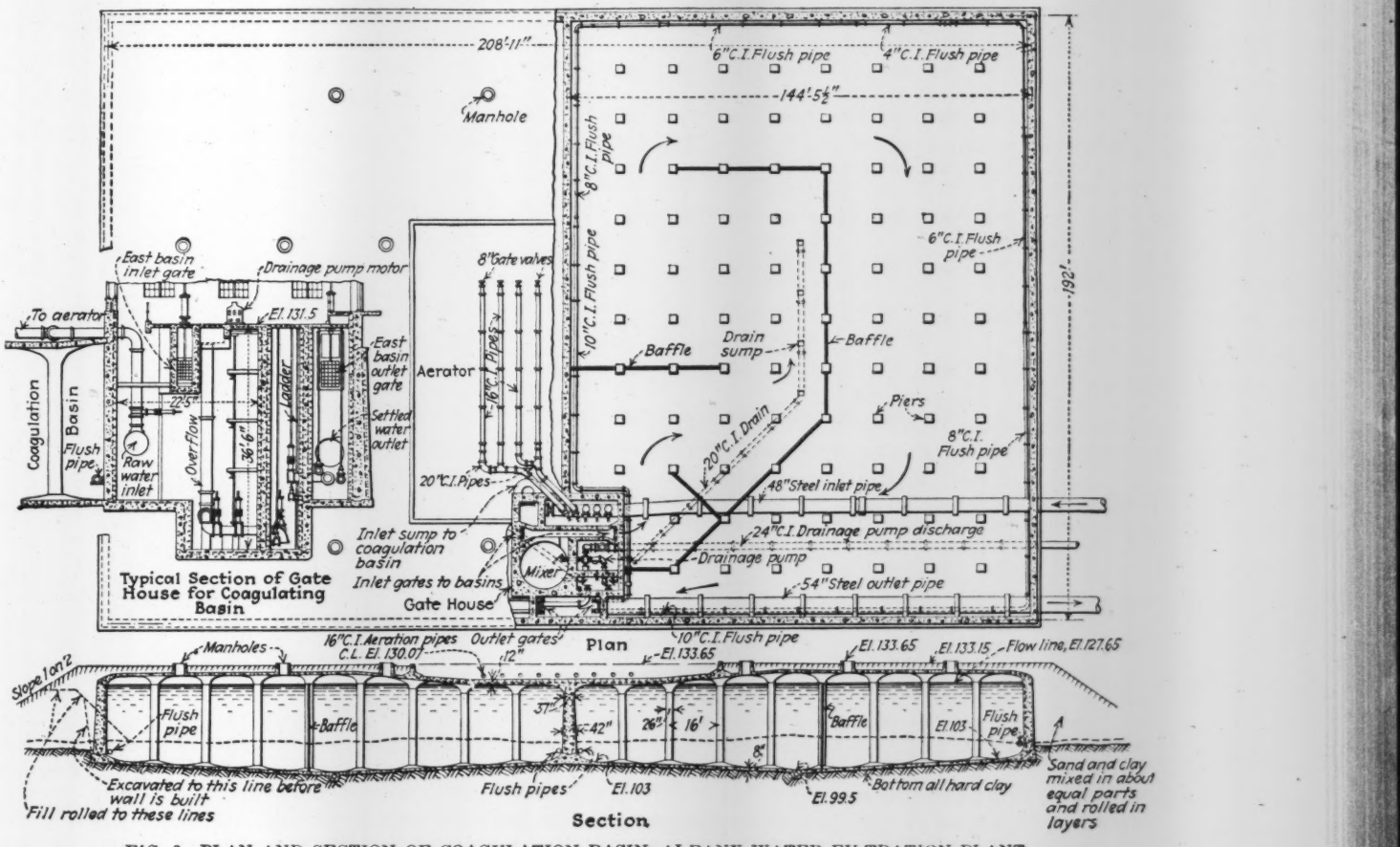


FIG. 3—PLAN AND SECTION OF COAGULATION BASIN, ALBANY WATER FILTRATION PLANT

The aerator rests on the roof of the basin. See also Fig. 5.

bottom by winds. Moreover, pumping the coagulated water to the pre-filters broke the floc into finely divided turbid matter, which passed deep into and sometimes through the filters, making a difficult load for the sand filters, and clogging them rapidly so it was hardly possible to keep them in operation. Bypasses were installed (there were none originally) and the pre-filtered water sent around the slow sand filters for mixing with their effluent. The heavy chlorination at such times contributed to unpleasant tastes and odors.

Coagulating Apparatus—The old solution feed coagulation apparatus was in an unsatisfactory condition and was housed in an unsafe wooden building. It was replaced by dry-feed apparatus (Fig. 2) with storage bins above, all placed in the old boiler house made available by an earlier shift from steam to electric pumping.

New Coagulating Basin—The old, open, settling basin having proved unsatisfactory as a coagulating basin and there being no safe way of operating the rest of the plant in case the basin was reconstructed, a new 10-m.g.d. covered coagulating basin in two compartments was built with an aerator on its roof. (See Figs. 3 to 5.) It is 289 x 192 ft. in plan, with a maximum water depth of 28 ft. It is of concrete, reinforced in places, with groined arch roof and floor, the latter inverted. The walls act as beams between the floor and roof. Earth covers the roof and surrounds the walls, the earth-fill pressure on the walls exceeding that of the water, so practically all of the concrete is in compression.

For the earth backing of the walls, clayey and silty material from the site, mixed with an approximately equal volume of borrowed gravel, was used. Fig. 4 shows the banks under construction; they were carried nearly to their full height and trimmed before the concrete walls were placed. The triangular space between each bank and wall was afterward filled with tamped puddle. Additional earth was then placed and the whole wedge compacted by a steam roller. This procedure, which is not new, prevents movement by settling of the outer foundation which would tend to rotate the wall and damage the roof which it supports. A few small steel rods were used in the roof to tie the blocks together during construction and prevent slight movements on the construction joints that are easily possible when such tall piers (about 30 ft.) rest on a clay foundation. As the bottom is all clay, water stops in the floor were not needed, but in the walls ¼ x 5-in. steel cutoff strips were placed in each vertical joint, besides the usual grooves in the concrete. There is no known or measureable leakage, here or in any part of the plant, new or old.

Coagulation Procedure—The dry-feed apparatus delivers the coagulant into the pump-well, from which it is passed through a venturi meter and 48-in. pipe to a cylindrical mixing chamber, either by way of the aerator on the roof or direct. The water is admitted to the mixing chamber at the bottom and leaves it at the top, tangentially in both cases. This whirls and gently agitates the water before it passes to one or both compartments of the coagulating basin, each of which is baffled and has its inlet and outlet close together, permitting convenient central control. As the building which houses the control valves is not heated, oil instead of hydraulic pressure is used for their operation.

To clean the coagulating basins pumping is necessary. This will probably be done only when the river is in

FIG. 4—VIEW OF EARTHWORK FOR COAGULATION BASIN AT ALBANY
The earth embankment surrounding the basin wall was built with natural slopes to nearly full height, as shown on left, and trimmed as shown on right. The concrete wall was then built, and the wedge-shaped space filled with earth.

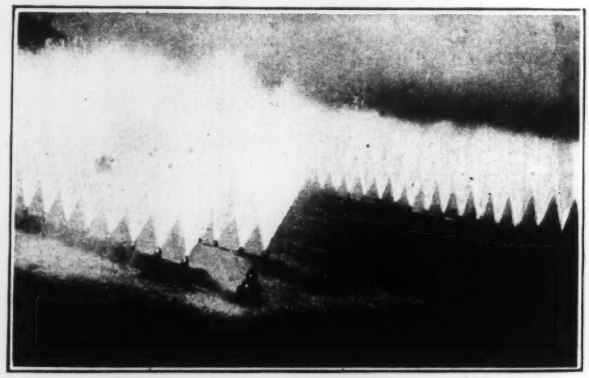


FIG. 5—AERATOR ABOVE COAGULATION BASIN
There is a blow-off gate at the end of each of the aerator supply pipes.

flood. The bottom of the basin slopes to a drain with a number of inlets. Perforated pressure pipes are placed around the base of the walls to aid the flow of the sludge to the drains as it lowers and lessens the finishing work of men with hose.

Revamping Pre-filters—Although the condition of the masonry of the old preliminary filters was generally good, the number of holes found and patched in the lower part of the structure suggested the need of greater precaution against leaks than is usually taken. In a single filtration plant, as most filter plants are, such leaks to the filtered-water collectors might be serious, especially with a highly-polluted water.

These and other repairs of the masonry filters were made with all possible rapidity in the fall of 1923, before starting other work. The old gutters and other wooden parts were replaced by reinforced concrete of new design. All the filtering material was replaced with new. Layers of trap rock and fine gravel of graded sizes to a total depth of 18 in., then 26 in. of Cape May filter sand with an effective size of 0.42 in. and a uniformity coefficient of 1.6. The strainer system, usually in good order, was repaired where needed. The inlet and outlet valves and other equipment of the pre-filters were repaired or renewed and put in good order.

Pre-Filtered Water Reservoir and Aerator—The old settling reservoir was cleaned up and affords 10 m.g. of storage between the pre-filters and final filters. The new use requires a lower water surface; which gives 6 m.g. less of capacity. Aerators (Figs. 6 and 7) with extra large connections to reduce friction losses, were provided to utilize a few feet of head. An out-of-use pump was installed for increasing the head if desired; and this was found especially useful during the winter. When used some of the outlets are closed and the head on the others increased. The intermediate aeration is advantageous, at times, for more complete removal of tastes, odors and carbonic acid, the latter with its tendency to promote corrosion.

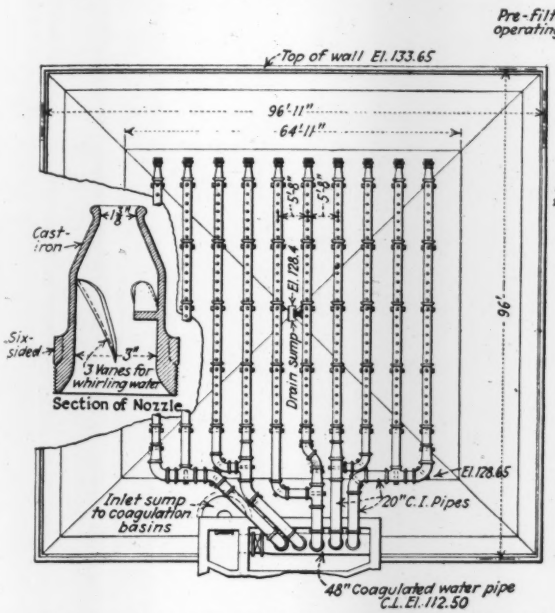


FIG. 6—PLAN AND NOZZLE DETAIL OF INFLUENT AERATOR

This aerator is on the roof of the coagulation basin and water from it goes to the basin.

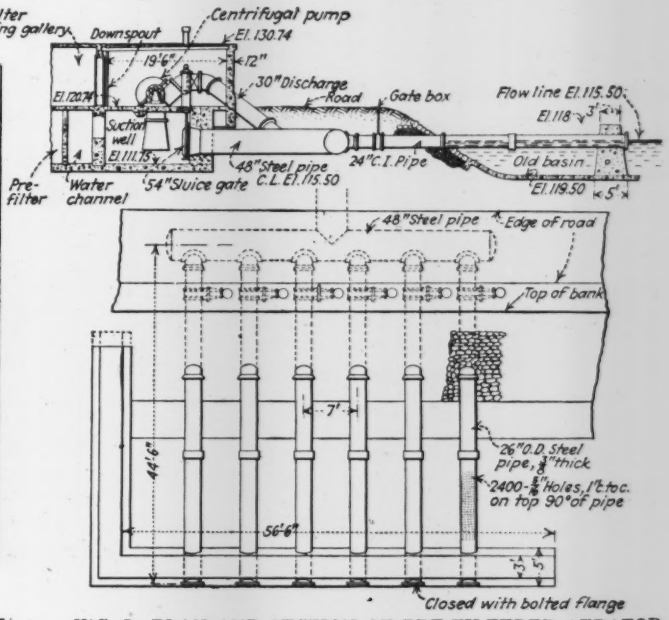


FIG. 7—PLAN AND SECTION OF PRE-FILTERED AERATOR

This aerator discharges into the original sedimentation basin which now serves as a pre-filtered water storage basin.

sand and gravel washed and screened on the site, were used. There were occasional irregularities in the setting of the concrete, but they were not very troublesome. The work so built has stood much better than some of later date, using cement of supposedly superior quality.

Interesting questions are raised by this experience as to the effect on longevity of the later requirements of fine grinding and the plaster admixture which is permitted and necessary with it. The filters were originally and still are watertight. Slight leaks in the brick walls between some of the units were too small to warrant repairs. The filter underdrains and filter gravel, although untouched in the 26 years since put down, seemed to be in good condition and were not disturbed. Omission of the inspection manholes at the end of the underdrains, provided at some later filters, has caused no trouble.

Most of the original filter sand remains in use. The sand washers originally provided had been allowed to fall into decay and disuse. In 1920, new sand was bought and much dirty sand removed and piled up outside the plant. The original sand was free from stones but the new sand was not screened with equal care, and occasional stones in it interrupted sand operations and added to their expense.

In the reconstruction, two sand washers and five 480-yd. cylindrical sand bins with conical bottoms (Fig. 8) were installed in the old sand court, with piping to move the sand from or to each of the eight filter beds. In 1925, the sand was removed down to the gravel in one filter bed (Fig. 9) and replaced with the sand obtained from cleaning the other filters or from the piles of waste sand already mentioned. All the sand was passed through one of the washers. The sand in the lower part of this bed, untouched for 26 years, was caked hard, but it, as well as that from the waste piles, seemed as good as ever after washing and fit for indefinite use. It is expected that the other seven beds will be renewed in the same way, but the process will take some years.

Indicating Apparatus—The original indicating apparatus, of simple sturdy construction, was found to be sound but as the maximum rate of filtration has been doubled new steel orifices of double the original area and new gage boards were provided.

Buildings—The original laboratory and office buildings had become overcrowded with the increase in capacity and complexity of the plant and some of the new equipment had been housed in numerous small wooden buildings. All these buildings have been replaced with adequate fireproof or semi-fireproof structures.

Flood Protection—The plant of 1899 was protected against the highest flood (1857) included in a long record. It was supposed that the deeper river channel would give flood relief and that a flood exceeding that of 1857 was unlikely; but in 1913 there was a higher flood and the water at the filters at the flood peak was 2 ft. higher than the river level two miles below. The plant was overtopped and put out of service for three days during which raw water mixed with some filtered water was pumped (*Engineering News*, Vol. 69, p. 754; *Engineering Record*, Vol. 67, pp. 374, 450). After the 1913 flood the embankments about the plant were raised 4 ft. and other provisions made for flood protection. As there had been no test of the new protection works in a dozen years, and as a probability study of the excellent records indicated the chance of overtopping the protection works at El. 24 to be only 0.7 per cent or once in 140 years, no further protection was provided. In case of a flooding emergency, chlorine could be applied to the limit, from apparatus installed in 1924 at the main pumping station two miles below.

Steel Conduit Under Canal—Questions as to the integrity of the 7,900 ft. of riveted steel conduit laid in the bed of the Erie Canal from the filters to the main pumping station in the winter of 1898-99 necessitated a study of related events which included inspection of portions of the pipe for physical and electrolytical conditions. The pipe was of ⅜-in. steel plates, coated with a bituminous compound, with all defective spots and joints treated after laying. Most of the pipe was laid in clay; a little in fine sand; about 300 ft. in shale rock. A minimum of 6 in. of concrete was placed around the pipe, except for 567 ft. on hard clay and some 300 ft. in rock, between the filters and the canal.

The city is dependent on this one conduit. It can be emptied and inspected only while water is supplied from the distributing reservoirs, or only for a few hours at a time, while at two depressions the conduit can be emptied by pumping only.

Some years ago, there was leaking in the 300-ft. section in shale rock not under the canal and where the pipe was not surrounded with concrete. Numerous perforations in the steel shell were then plugged and the pipe surrounded with concrete. These perforations caused anxiety as to the condition of the pipe beneath the canal, which it was feared might be admitting polluted canal water, especially during high floods, at which times only there would be inward pressure.

Tests made after the writer took up the reconstruction work showed a flow of electric current through the conduit sometimes in one and sometimes in the other direction, due to electric railway track near the lower

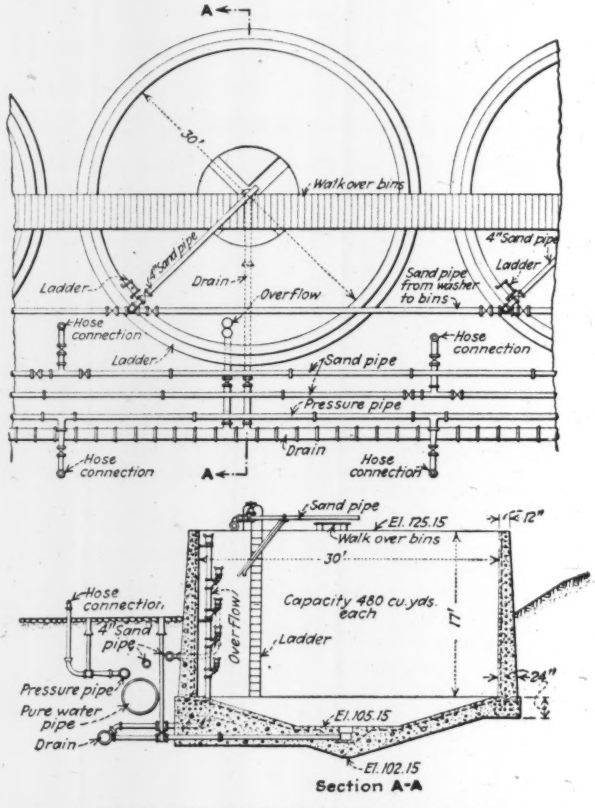


FIG. 8—PLAN AND SECTION OF SAND STORAGE BINS

end of the conduit and near an 8-in. water main that approaches close to the upper end of the conduit. The deterioration of the 48-in. pipe, already mentioned, had been caused by this current; inspection of the conduit, but not for its whole length, showed no damage elsewhere.

Inspection of about 60 per cent of the pipe interior showed some turbercles and blisters, but generally the pipe was found in good condition. On removing some of the tubercles, a few pits were found extending nearly through the pipe, but only one leak was developed in that way and it was small. The tuberculation had not materially decreased the carrying capacity of the pipe, which is still 25 m.g.d. by gravity, the capacity assumed in the original design. Chemical and bacterial analyses showed no evidence of pollution by canal water.

The origin of cases of typhoid fever in Albany in May, 1924, has never been determined. It might have been caused by back pressure to the distribution pipes from some polluted industrial supply, several of which were found and removed at the time. One suggestion was that the typhoid was due to inward leakage of

canal water to the conduit during the April floods, but the single unsatisfactory bacterial test reported at the time is insufficient for important conclusions. Directly after the incident, chlorinating apparatus was installed at the lower pumping station and ever since then the filtered water delivered by the 48-in. conduit has been chlorinated.

Booster Pumping Station—To guard against leakage into the 48-in. conduit and at the same time increase its delivery capacity from 25 to 30 m.g.d. or more, a booster pumping station was built at the upper end of the conduit and a weir at the lower end. This insures an excess of internal pressure at slight capital outlay and with little probable increase in operating expense, as it may not be necessary to operate the pump much of the time.

Operating Method—Treatment of water by the reconstructed plant follows more or less closely that used for some years at Poughkeepsie, N. Y. The Poughkeepsie results for five years are considered in what follows as well as those at Albany for a shorter period. Hudson River water to which sulphate of alumina has been added in the pump well is passed through the aerator and mixing chamber already described, with a 10-minute total mixing period at a 30-m.g.d. rate, or 14 minutes at two-thirds that pumpage, which is more nearly the average. The detention period in the coagulation basin is 8 hr. at the 30-m.g.d. rate. The pre-filters, with two out of service, work at 115 m.g.d. per acre for 30 m.g.d., but ordinarily 75 m.g.d. The pre-filtered water passes through a second aerator, for the purpose already stated, then through the old settling or present equalizing basin, and then to the old slow sand filters, now operated at 6 m.g.d., or double their original rate when the water was aerated and settled only. The ample capacity of the underdrains and pipe connections makes the higher rate possible without a sufficient increased loss of head to warrant changes. By coagulation, pre-filtration and double aeration the water that goes to the slow sand filters is about equal in quality to that from a standard mechanical or rapid filtration plant. The slow sand filters convert the free ammonia into nitrates—almost completely in summer and less so in winter. All the easily oxidizable organic matters are disposed of and with them a large part of the tastes and odors that escape in the earlier processes. With the latter working well there is very little clogging of the slow sand filters. At Poughkeepsie a bed sometimes operates six months without cleaning.

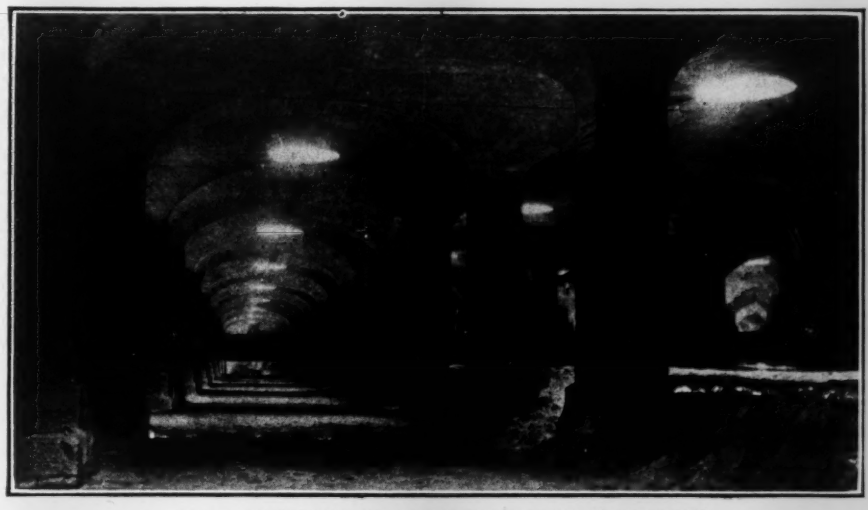


FIG. 9—INTERIOR OF ALBANY SLOW SAND FILTERS
Sand being washed to the bottom after 26 years of use.

The operation of sand filters under such conditions throws a sidelight on the operating results of mechanical filters, for at times the slow sand filters are clogged more rapidly than at others, due to the material which passes the pre-filters and is retained by the more perfect straining action of the slow sand filters. With water difficult to coagulate, it frequently happens that hydrate of alumina combined with organic matter passes through the pre-filters in some soluble or colloidal form in quantities large enough to clog the slow sand filters with astonishing rapidity, and this even when the pre-filters are in good order. The slow filters remove this material better than do the rapid filters, but it is better and cheaper to keep the pre-filter treatment so tuned up that little clogging material goes to the slow sand filters, there to increase the frequency and cost of cleaning.

Early Results—During November, 1925, with river water containing very difficult organic matter requiring a high dose of coagulant the average color was reduced from 55 to 8. Total hardness was not increased but a considerable part of the carbonate hardness was changed to sulphate hardness. Oxygen consumed, representing organic matter, was reduced by 80 per cent. Carbonic acid, starting at about 3 p.p.m., was increased to about 30 p.p.m. by chemical treatment and reduced to about 7 p.p.m. by the first aerator—second one not then completed. Bacteria in the raw water averaging 67,500 per c.c. were reduced to 4,950 in the coagulating basin, to 300 by the pre-filters and to 5 by the slow sand filters,

COST OF CHANGES AND IMPROVEMENTS IN ALBANY FILTERS, 1923 TO 1925, INCLUSIVE

Installing new pumps and heating system in old pumping station, and new room for applying chlorine to raw water		$32,724
Main outside lines of steel pipe, with Venturi meter		58,180
Coagulating basin, holding 10 m.g.:		
Earthwork, 64,600 cu.yd. at average $1.53	$98,842	
Concrete, including steel reinforcing, 8,700 cu.yd. at average $15.10	131,342	
Gates, piping, drains, drainage pump, and aerator equipment	44,931	
Building, baffles and miscellaneous	25,425	300,540
Repairing and improving preliminary filter, and new coagulating equipment	$69,763	
New filtering material	17,275	87,038
Aerator for effluent from preliminary filters, including resetting one old pump, and building changes for it		21,510
Installing new sand washers and a complete system of sand washer piping and electric lights in the old filters, sand bins, new outlets for the old basin, repairing old gates and miscellaneous work		68,440
Laboratory and coagulant storage building		23,470
Service building, with separate chlorine rooms		17,510
Booster station, including cutting old pipe, building two shafts, gates, pump and wooden pump house		35,180
Sum		$644,592
For engineering, including preliminary work		54,527
Total		$699,119

after which the water was chlorinated. Without the chlorine, less than 1 in 10,000 of the bacteria in the river water were left. The original filters, in 1900, left less than 1 in 100. In a general way the present treatment reduces the number again in the same ratio. In a quarter century, pollution has doubled, but purification efficiency has increased at a much greater rate. The filtered water of those days was very satisfactory in comparison with the raw water that preceded it, and good when compared with the raw water from upland sources used by other cities, but it would not meet with the critical requirements of present day laboratories.

Cost—The reconstruction work in 1923-5 cost about $700,000 (see table). The original plant of 1897-99, including low-lift pumps and pump line to the main pumping station, cost about $500,000. Some $300,000 was spent in 1907-09 for the intake extension, coagulating plant and pre-filters. Change from steam to electricity and minor items through a term of years may have cost $100,000. The total outlay from 1897 to 1925 inclusive, was about $1,600,000.

The work was begun under the direction of F. A. Raven, commissioner of public works, and finished under his successor, Lester W. Herzog. J. Murray Prior was superintendent of water-works, and George E. Willcomb is supervising chemist. The designs were made in the office of Hazen & Whipple, with my partner C. M. Everett in direct charge. F. H. Hapgood of the same office was resident constructing engineer. Most of the work was done by contract, a small amount by day labor, but minor repairs were made by the filter operating force.

Architect of Knickerbocker Theater Not Responsible in Damages

Reginald W. Geare, architect, of Washington, D. C., who drew the plans for and supervised the construction of the Knickerbocker Theater in that city, which collapsed on Jan. 28, 1922 (the collapse was described in *Engineering News-Record*, Feb. 2, 1922, p. 207, and Feb. 9, p. 224), killing about one hundred persons, has been held not responsible in damages in a suit brought by the administrator of the estate of one of the victims of the accident. The decision follows that in the case of the steel contractor on the theater, John H. Ford, which was reported in our issue of Aug. 19, 1926, p. 291. Geare, like Ford, demurred to the declaration in an action of Guy Sturgis, administrator for the estate of Victor M. Sturgis, for negligence causing death, but the Supreme Court of the District of Columbia overruled the demurrer. The Court of Appeals of the District now reverses the action of the lower court. This final decision is based on the court's previous decision in the Ford case. Its full text follows:

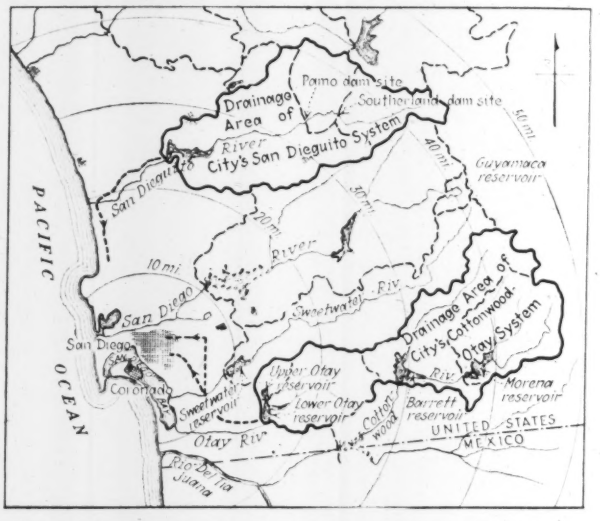
We think the issues involved in this appeal are essentially similar to those in John H. Ford, appellant, vs. Guy Sturgis, administrator of the estate of Victor M. Sturgis, deceased, appellee, Appeal No. 420, ante, the decision in that appeal being handed down concurrently herewith. It is true that the appellant in that case was a contractor furnishing material and services in the construction of the building, whereas the present appellant was the architect of the building, but we think that fact is immaterial. Consistently with the decision in the former case the order of the lower court challenged by this appeal is reversed with costs and the cause is remanded for further proceedings not inconsistent herewith.

Recreational Use of San Diego's Water-Supply Reservoirs

Despite Popularity, B. Coli Index is Zero—Dry Climate, Long Retention and Strict Sanitation are Factors

By R. C. Wueste
Supervisor, San Diego Municipal Impounding System

RECREATIONAL use of reservoirs has been practiced in San Diego County, California, for forty years, beginning with the first development of local water supplies, and thus a public sentiment has been developed which regards this use of the artificial lakes of the county as one of the privileges of citizens. The income from fees charged for these recreational privileges has come to be an important factor in both public and private water development ventures and since there is not a single instance of an epidemic of water-borne



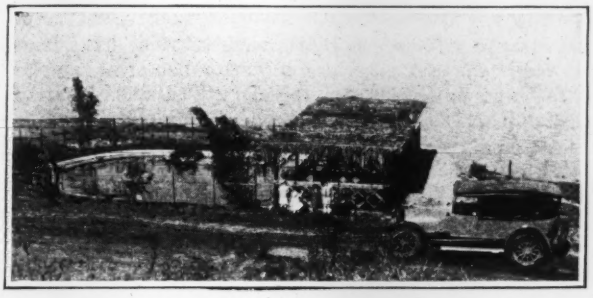
RELATIVE LOCATION OF SAN DIEGO'S RESERVOIRS

origin there appears to be no reason for discontinuing the present practice. Conditions in San Diego County that affect the storage of water supplies and the precautionary measures taken to safeguard the purity of water under recreational use, are outlined in the following.

Speaking very generally, as one travels east from the Pacific Ocean in San Diego County a belt of elevated coastal bench about ten miles wide is first crossed. This ends abruptly against a porphyry dike cut by defiles where the major drainage channels break through to the coast. Then comes the true runoff producing area of the county, a 30 to 40-mile belt of broken and mountainous territory bounded on its eastern margin by a divide, 4,000 to 6,000 ft. in elevation, which overlooks the Imperial Valley. The highly irregular topography of this mountainous area makes it remarkably rich in dam and reservoir sites but is devoid of natural lakes.

The rainy season begins in December and during three or four following months the dry watercourses are periodically converted into torrential streams flowing swiftly from steep watershed slopes and cascading down boulder choked gorges to the sea. Thus there

are no perennial streams and the few natural lakes filled during the rainy season are evaporated to dryness during the summer months. Under these conditions when artificial lakes are formed by the construction



TROUT NURSERY ON WATER SUPPLY RESERVOIR
About 20,000 trout fry from a state hatchery are planted in this nursery in the fall. When they reach a length of 7 in. they are put in the reservoir. Floating nursery in the distance.

of dams the lure and fascination of a lake playground immediately create a demand for recreational use.

Ground-water supplies in this county are very limited and are regarded as emergency sources only. The only means to an adequate water supply is the construction of dams which will impound and retain from season to season the erratic winter flood flows, thus securing a regulated gravity supply. The cost of these storage projects has varied between $500,000 and $1,000,000 per m.g.d. of safe net yield. This makes water production in this county relatively expensive in the matter of interest on the money invested.

The watershed areas are predominantly granitic in character, incompletely overlain with soil suitable for agriculture, sparsely wooded and sparsely populated. In 1915 a watershed census of areas tributary to the municipal reservoirs showed less than one permanent resident per square mile. In the ensuing eleven years this population has increased chiefly in certain camp- and cabin-site areas which have developed as nuclei. Sanitary control for population of this sort is comparatively easy and the watersheds as a whole are subject to a natural 7-months dry sterilization period during which chance pollution undergoes immolation by exposure to sun and wind.

The runoff-producing area in San Diego County consists of about 2,000 sq.mi. of which about one-third is in the Cleveland National Forest. Altogether about two-thirds of the runoff-producing area is still public domain. It is not believed that these proportions will ever be materially changed.

The Forest Service, in co-operation with the state, exercises sanitary control over camps in the forest, and by an agreement between the city of San Diego and the Forest Service the city passes on all applications for homesteads within the watershed areas of the city.

An important factor in the high quality of the impounded raw water is the long retention period under the algebraic relationship of runoff, draft and loss which have to be considered in working out the watershed performance problem. The retention period for the bulk of the stored water is from 1 to 10 years. The policy has been to provide reservoir capacities of from 2,000 to 6,000 m.g. per 1 m.g.d. of safe net yield. During these retention periods mechanical subsidence, working of the biological balance and the seasonal bio-chemical cycle and sterilization by sunlight and air are held responsible for the generally low bacterial counts found in local stored raw water. Copper sulphate treatment when necessary for algal control also accelerates the subsidence of suspended matter, including bacteria.

Privately owned water companies in San Diego County, including those that supply potable water, are all featuring recreational use of their reservoirs. The income from this use has increased during the last few years to significant sums, forming appreciable parts of the revenues. There is, therefore, a capitalization of this feature of a San Diego County water development which is written into the valuations of the systems.

The appended table of revenues from recreational use of reservoirs on the Cottonwood-Otay system shows the increasing volume of recreational use. A detailed analysis of this table would bring out influences which have produced the income changes but it is sufficient to show that the average annual increase has been about 48 per cent since 1922. This increase is, in the main, proportional to the average numerical use increase. The increase in the future, it is believed, may be assumed to be at least as great as the increase in regional population.

GROSS RECEIPTS FROM RECREATIONAL USE OF COTTONWOOD-OTAY SYSTEM RESERVOIRS

Year	Receipts	Year	Receipts
1913	$758	1920	$3,531
1914	1,408	1921	396
1915	1,197	1922	8,215
1916	488	1923	16,481
1917	348	1924	19,677
1918	1,853	1925	24,440
1919	4,856		

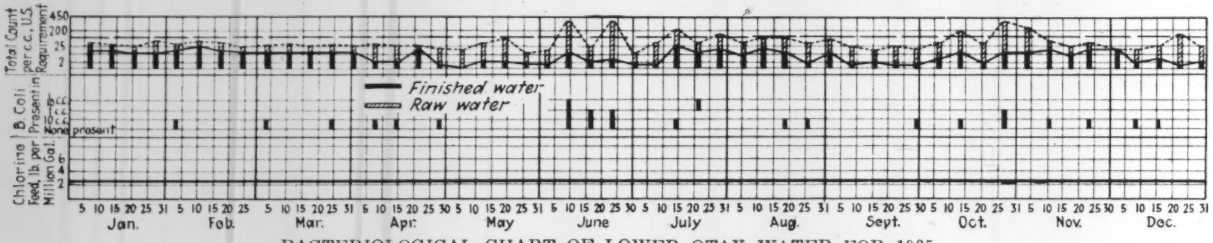
BLACK BASS FROM A SAN DIEGO RESERVOIR
All San Diego's reservoirs have been planted with game fish and fish are considered a necessary factor in the biological balance of the stored water.

The costs to the city, including only interest and depreciation on the equipment used and operating salaries of employees handling recreational affairs, are about 25 per cent of the gross receipts. This income is classed, by charter provision, as a "miscellaneous receipt" and must be deposited in the general fund. Anticipated revenues are estimated by the city auditor and operating expenses are budgeted a year in advance.

The impounding branch of the city's water system

has been controlled in various ways since its purchase in 1913. At that time each councilman acted as superintendent of a department and the impounding system was placed in charge of the legislative water superintendent. Two years later a semi-manager form of city government was adopted, placing the impounding system under the manager of operation. After four years, a special commission was created to deal with water development and the operation of developed works. In 1923 this commission was abolished and the impounding system returned to the manager of operation.

Since that time recreational use of the impounding reservoirs has received its greatest attention. There has been co-operation with the California Fish and Game Commission along lines calculated to increase the public's enjoyment of the reservoirs, and particular attention has been given to the planting, rearing and transfer of fish. Waterfowl hunting has been regulated to afford sport for the greatest number of hunters; a bulletin of information and regulations affecting the municipal reservoirs has been published; conveniences



BACTERIOLOGICAL CHART OF LOWER OTAY WATER FOR 1925

and facilities for campers have been installed and reservoir beautification tending to increase the attractiveness of the reservoirs to the public has been undertaken. Thus the incentive for the public to visit the reservoirs, if only to picnic, has been greatly increased.

The psychological effect of a clean camp ground provided with trash receptacles, modern toilet facilities, clean and well kept boats, well constructed boat landings, trim reservoir shore lines and terse and dignified warning notices, can hardly be overestimated. The result is the development of a public conscience. The theory that provisions for decency will eliminate 95 per cent of possible indecencies appears to work out satisfactorily. Public conscience must be sufficiently developed, else recreational use of domestic supply reservoirs becomes impossible and untenable.

Since the Cottonwood-Otay system furnishes about 75 per cent of the city's water which must finally pass through Lower Otay reservoir, public use of this reservoir carries increased responsibilities. Certain provisions and regulations which have been put into effect on this reservoir will be extended to all city reservoirs in the future. These sanitary control measures are:

(1) Shore line toilets of pan type placed at one-half mile intervals.

(2) Parking of automobiles restricted to designated areas marked by signs and provided with garbage cans and pan toilets.

(3) Overnight camping restricted to station headquarters on an area draining away from reservoir and provided with garbage cans, flush toilets, street lights and other conveniences and attractions.

(4) Daily shore and water patrol by car and motorboat for supervision and surveillance of permittees.

(5) Maintenance of all elements in high state of cleanliness and orderliness.

Although nearly all surface water entering San Diego since 1906 has been filtered by rapid pressure filters, sterilization was not begun until the fall of 1915. At no time has the raw water been of such a character that its use without sterilization would not have been allowed in the city. Results of weekly bacterial samples of raw and finished water during the calender year of 1925 at the Lower Otay filtration plant are shown in the accompanying diagram. In the upper graph the tops of the columns represent the total bacterial count per c.c. in the raw lake water. The bacterial reduction by filtration and sterilization is shown on the same columns. In the middle graph are shown the positive samples for B. coli. The lower graph shows a continuous chlorination of 2½ lb. per m.g. during the year.

Although about 40 per cent of the raw samples reacted for colon bacilli, the low total count and other considerations place the cause of this on bird pollution. In the finished water, no samples showed positive, giving a zero colon index. Water from this plant is transmitted by 19 miles of closed conduit to San Diego, where the colon index is still found to be zero with only a slightly higher total count.

The San Diego reservoir system now includes five of the nine major impounding reservoir developments within the county. The city controls 59 per cent of the county's available drainage collection area. Further developments will doubtless be made by the city, by reason of the need for more water. Should controlling factors or conditions change, should the precautions noted in the foregoing become inadequate, or should the purity of the supply stand in jeopardy, a cessation of recreational use would doubtless result. Until such danger appears reasonable, the present policy of allowing recreational use will probably continue.

Underfeed Sludge-Drying Beds at West Kent

The sludge-drying beds of the new sewage-works of the West Kent Sewerage Board, England, opened in July, have the sludge delivered at points 1 in. above the surface of the beds, beneath the sludge already applied, to prevent disturbance of the partly dried sludge. There are 36 beds, with a total area of 513,000 sq.ft., or over 12 acres. They are composed of 9 in. of "ashes," underdrained, and receive sludge from hopper-bottomed sedimentation tanks, the influent to which has been passed successively through "rough screens," a 5½x3⅜-ft. Venturi meter, "mechanical screens," and detritus tanks. From the drying beds, sludge is removed by 1-yd., 18-in. gage railway cars drawn by gasoline motors and delivered to a "river wharf and to a land tip for distribution to farmers," according to an article describing the sewage-works and trunk sewers published in the London *Surveyor* of July 9, 1926, p. 27.

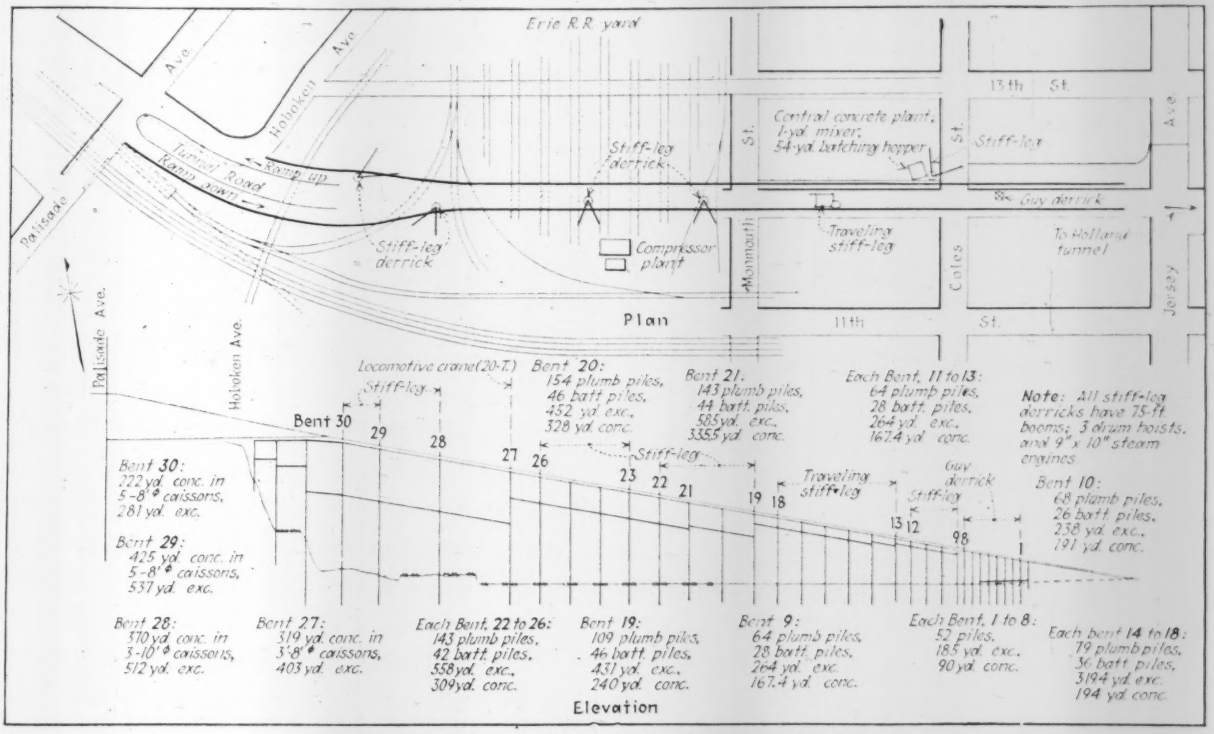
An Eight-Derrick Outfit Constructs Seventy Footing Piers

Skillful Selection and Location of Derricks Limits Construction Plant Shifts on 2,300-Ft. Viaduct to Two Mobile Units

PLANT selection and arrangement were something of a problem in putting down seventy footing piers for the thirty-bent steel viaduct connecting the west end of the Holland vehicular tunnel from New York with the 70-ft. ridge west of the shore flat of Jersey City. Besides the large number of separate operations there was a wide variation in soil and water conditions which required changes in methods. Care had to be taken also of a 72-in. riveted pipe sewer running between the twin footings for most of the length of the viaduct. More important, however, was the necessity of carrying on work across two streets and a railway yard of some 30 tracks which had to be kept in service. Fast work was another requirement, as the viaduct is part of the arterial road west from the tunnel which is planned to be in operation this year. A description of the road and of the viaduct structure was published in *Engineering News-Record*, April 30, 1925, p. 731.

Altogether the work called for 2,920 piles, 10,420 cu.yd. of excavation and 6,333 cu.yd. of concrete. The distribution of these quantities is indicated on the drawing. The length of the operation was 2,300 ft., and its width was within 50 ft. Commonly in a case like this consideration would be given to some sort of traveling outfit, but here there were the interrupting streets and railway yard and moreover along much of the route old buildings had to be torn down. The logical plan appeared to be to attack the work at several points, mainly with independent plant units, but to arrange each unit so as to handle a group of footings from one set-up. The plan adopted is shown by the drawing; stiff-leg derricks, a guy derrick, a locomotive crane, and a traveler were the plant units included.

At the east end of the viaduct the first eight bents were comparatively close together and a guy derrick was selected as being able to cover all 16 footings. For the eight footings of the next four bents a stiff-leg derrick was chosen and since the location of the mixing plant was somewhat inflexibly fixed at Gales St., over which all materials were brought in, the derrick was set to serve the mixer bins as well as the footings. West to the railway yards there was then a clear way for a traveling outfit and a stiff-leg was put on wheels and a 40-ft.-gage track was laid. This outfit covered the 12 footings of bents 13 to 18, inclusive. In the railway yard two stiff-legs covered four bents each and one bent was handled by a locomotive crane. More general use of locomotive cranes in the yard area was prevented by the continuous use of the tracks for train movements. Then two stiff-leg set-ups provided for the remaining piers.


Erie R.R. yard
Hoboken Ave
13th St.
Central concrete plant, 1-yd. mixer, 54-yd. batching hopper
Stiff-leg derrick
Stiff-leg
Guy derrick
Tunnel Road
Ramp up
Ramp down
Palisade
Stiff-leg derrick
Compressor plant
Traveling stiff-leg
To Holland tunnel
Monmouth
Coles
Jersey Ave
Plan
11th St.
Palisade Ave.
Hoboken Ave.
Locomotive crane (20-T.) Stiff-leg
Bent 30
Bent 20: 154 plumb piles, 46 batt piles, 452 yd. exc., 328 yd. conc.
Bent 21: 143 plumb piles, 44 batt piles, 585 yd. exc., 335.5 yd. conc.
Each Bent, 11 to 13: 64 plumb piles, 28 batt piles, 264 yd. exc., 167.4 yd. conc.
Note: All stiff-leg derricks have 75-ft. booms; 3 drum hoists, and 9" x 10" steam engines
Bent 30: 222 yd. conc. in 5-8' ϕ caissons, 281 yd. exc.
Bent 29: 425 yd. conc. in 5-8' ϕ caissons, 537 yd. exc.
Bent 10: 68 plumb piles, 26 batt piles, 238 yd. exc., 191 yd. conc.
Bent 28: 310 yd. conc. in 3-10' ϕ caissons, 512 yd. exc.
Bent 27: 319 yd. conc. in 3-8' ϕ caissons, 403 yd. exc.
Each Bent, 22 to 26: 143 plumb piles, 42 batt piles, 558 yd. exc., 309 yd. conc.
Bent 19: 109 plumb piles, 46 batt piles, 431 yd. exc., 240 yd. conc.
Bent 9: 64 plumb piles, 28 batt piles, 264 yd. exc., 167.4 yd. conc.
Each Bent, 1 to 8: 52 piles, 18.5 yd. exc., 90 yd. conc.
Each bent 14 to 18: 79 plumb piles, 36 batt piles, 319.4 yd. exc., 194 yd. conc.
Elevation

PLANT ARRANGEMENT FOR SEVENTY VIADUCT FOOTINGS

The derricks handled concrete buckets and the leads for piledriving and the orangepeel bucket for excavation. Open caissons were sunk at the westernmost four bents; all the other footings were open-pit operations. Concrete came from the central mixing plant in buckets on trucks; plank roads were laid for the truck operations. Altogether none of the work presented any complexity. It was very effectively handled by the outfit, which included only general purpose equipment.

The contractor was the Frederick Snare Corp., New York. The viaduct is being built for the New Jersey State Highway Commission, W. G. Sloan, engineer.

Railway Developments in Africa Show Increasing Needs

Pioneer Character of Many Lines Inadequate for Present Freight and Passenger Needs —Changes Recommended

WITH industrial development in central and southern Africa, and the prospective linking up of inland railways with those advancing from the east and west coasts, there will be changes in transportation conditions, as indicated by a report on the railways of the British colony of Southern Rhodesia, made for the governor by Gen. D. F. Hammond as a result of public complaints regarding rates and service. The railways serving this colony aggregate 2,462 miles, all of 3½-ft. gage, and 1,252 miles are within the colony. All the lines are controlled and operated by the British South

RAILWAYS OF SOUTH AND CENTRAL AFRICA

Africa Co., except that one stretch of 588 miles is operated by the South African Government Rys. and part of the main line north to Bukama, in Belgian territory. Their coast connections are mainly eastward to the Beira Ry. and the port of Beira in Portuguese East Africa, but there is also connection with the South African Ry. to other ports at greater distances, as shown by the accompanying map.

For the Southern Rhodesia railways the capital cost averages $30,000 to $36,000 per mile, as compared with $51,000 for the South African Government Rys. and $56,750 for the Uganda Ry., northeast of Rhodesia. To the northwest is the Belgian Congo, with railways that will in a few years be connected with the ports of Portuguese West Africa. General Hammond sees the possibility of much traffic eventually going from Rhodesia to these west ports instead of east ports.

The Rhodesian railway system is of a pioneer character, with narrow roadbed and little or no ballast. But the traffic has grown to such an extent that maintenance work is costly, while frequent derailments interrupt traffic to a serious extent. Widening and ballasting of the main line are programmed for the next five years at $3,360 per mile. The maintenance force is considered too small, track men (natives) averaging 1.8 to 2.7 per mile, with European foremen for 7-mile sections. General Hammond believes that with a larger force the cost of work and the number of derailments would have been much less. Furthermore, as the lines are only 25 to 30 years old, it is evident that the period of renewals is only just beginning. Improvements at Beira are needed for both shipping and railways, but the Portuguese port company has declined to authorize such works.

Purchase or control of the railways by the colonial government is advocated. In the event of failure to arrive at such an agreement or failure to secure adequate facilities at Beira, the report recommends the construction by the colonial government of a railway from the Rhodesian main line to Messina, a terminal point on the South African system. Since the railways are not worked to full capacity, General Hammond opposes the construction of proposed competitive new lines and of cutoff lines to shorten distance, unless they will develop enough local traffic to warrant their construction, as a few hours' difference in time of transit is unimportant with the majority of the freight. He says: "The great object is the creation of new traffic, not the substitution of new routes for old ones." Road rail transport has possibilities for comparatively short lines, but this system is only in the experimental stage.

The departmental system of operation is in use on the Rhodesian lines, as is usual with British railways, but General Hammond favors the divisional system as giving more direct control, avoiding the delays and friction incident to divided responsibility and reducing cost of operation. These advantages, he says, have been demonstrated on the South African railway system and the Uganda Ry.

Prisoners Build Important California Road

The California Highway Commission has recently completed an important 17-mile stretch of main-line highway using convict labor exclusively. This is the new road into Yosemite National Park, located through the canyon of the Merced River that drains Yosemite Valley. This road provides an all-year vehicular route into the Valley heretofore reached by automobile only via steep mountain roads that climb over elevations of 7,500 or 8,000 ft. to reach a destination of about El. 3,000. The fact that convict labor could complete this job at the rate of speed required on such an important route is stressed by the California Highway Commission whose chief engineer, R. M. Morton, said at the dedication ceremony of the new road: "Prior to 1923 there had been constructed by convict labor over 200 miles of California state highway, all of it, however, in remote locations and on roads that could not be classed as primary." With respect to present labor costs Mr. Morton said, "The cost of operating prison camps will average about $6 per day for each prisoner in camp. This includes the prisoner's wage of $2.10 per day, the wages of skilled free workmen, the operation of equipment and the purchase of construction materials."

Letters to the Editor

A FORUM FOR DISCUSSION OF VIEWS OF ENGINEERS AND CONTRACTORS

Modern Column Formula Based on Old Tests

Sir—I have before me the specifications for tanks of the National Fire Protection Association, adopted at the annual meeting at Atlantic City in May Under Section 11, Unit Stresses, paragraph 1103, I find the following: "Axial Compression: Gross section of columns and struts, 17100–57 *(l/r)*, with a maximum of 12000," etc.

This ancient column formula was derived from tests made on wrought iron Z-bar columns by C. L. Strobel forty years ago. Compared with modern column formulas it gives too low allowable stresses for low values of *l/r*, and too high allowable stresses for high values of *l/r*.

Albany, N. Y., Aug. 2, 1926. C. H. WOOD, Senior Assistant Engineer, State Engineer and Surveyor.

A Notable City and County Geodetic and Topographic Survey

The pamphlet on the Geodetic and Topographic Survey of Pittsburgh, by U. N. Arthur and R. H. Randall, noted briefly in your Engineering Literature Section of Aug. 19, p. 312, deals with work that sets a new mark of excellence for city surveys in the United States.

Accurate triangulation is the cement in the concrete of a city survey. If the cement is strong and well proportioned the most important factor is assured. Precise levels might be called the sand and water—should be of good quality and well proportioned—and with good triangulation make a strong mortar. Primary traverse, secondary levels and plane-table work may be likened to the coarser aggregates—they are much the same from one city to another.

The geodetic work—the horizontal and vertical control—is too often slighted because the methods of securing and adjusting it are little understood by the average engineer.

The Pittsburgh triangulation net is unusually well proportioned and unusually strong, as shown in its adjustment, where eleven base lines, measured to an accuracy of 1 in 500,000, were used to control 103 triangulation stations in such a way that figured through from one base to another the discrepancy was less than 1 in 100,000 before final adjustment.

An ordinary steel tape will stretch ¼ in. if pulled 20 lb. An accuracy of 1 in 100,000 means, then, the correct length of this tape to a hairs-breadth after temperature, stretch, sag, slope, elevation above sea, and other factors are accounted for. It means measurements after midnight, applied with special methods, with half a dozen different tapes, after comparison with national standards, and many other things as described in the paper.

It is worth all this to have a supreme court for city surveys. The present writer is familiar with a city where several different sets of marks or monuments are used according to the surveyor who is called upon to make locations. This can arise from differences in interpreting legal documents, but, in the same city different surveyors have used different elevations for the same point. There should be but one supreme court for elevations—mean sea level; and there should be but one supreme court for horizontal positions—North American Datum.

The Pittsburgh survey is founded upon both these ultimate bases, and its accuracy is such as to do away with disputes for many years to come, after land values have increased enormously over present figures. Herein lies economy, for, just as it costs little more to make good instead of poor concrete (the forming, plant equipment, overhead and other items are alike for both good and bad) so, in contrast with indifferent control, it costs little more to secure good geodetic work. Upon the latter, future surveys showing all kinds of details for all kinds of purposes can be based with confidence. One result of a good geodetic and topographic survey is a mother map from which usually a brood of other maps spring. The progeny will be good or bad according to the original parentage.

The Pittsburgh survey is further excellent in that its control is being extended over surrounding territory to cover Allegheny County. This provides for regional instead of local city planning. The Allegheny County authorities and the Pittsburgh Planning Commission can not be commended too highly for their co-operation in this matter. It again sets a mark for other metropolitan areas in the country.

The excellence of the office computations and mapping is in keeping with the work in the field. The paper describes these and other features in as much detail as 45 pages of printed matter permit. A reproduction of a finished sheet in colors from the engraving plant of R. H. Randall and Co. is given in the paper. The writer visited this plant at Toledo in connection with helping to start similar work at Columbus, and was impressed with the aluminum mounted field sheets (which prevent moisture changes of paper in the field) and with the precautions taken to bring down the field sheets to accurate reproduction scale and insure registration of colors to 0.01 inch.

The scale of the published Pittsburgh maps is 200 ft. per inch. The contour interval is 2.5 or 5 ft., as dictated by the character of the relief. Culture is shown in black, contours in brown, water features blue, and public grounds in green, giving great clearness and utility to the series. Property maps to a scale of 50 ft. per inch are also contemplated and can easily and accurately be made from the geodetic survey because the latter is directly and conveniently connected to the monuments and marks hitherto used for property surveys in that region.

It is a tribute to the engineering profession to find that the local engineers at Pittsburgh are supporting accurate work there. It would have been hard twenty-five years ago to secure such a survey for lack of such support. Perhaps the easiest way to visualize this progress is to go still further back into history when the first surveys were made in southwestern Pennsylvania under the old Virginia law of 1779, which allowed a discrepancy of 5 acres in each 100 on account of poor instruments and other surveying difficulties.

As stated in your notice, those interested may secure copies of the paper on the Pittsburgh and Allegheny County survey from the Pittsburgh Planning Commission, under whose direction the work is being done, or from R. H. Randall & Co., Toledo, Ohio.

Columbus, Ohio, Aug. 23, 1926. C. E. SHERMAN, Professor of Civil Engineering, University of Ohio.

In Defense of Steel Buildings

Sir—Reference is made to a communication from C. A. P. Turner on p. 313, *Engineering News-Record*, Aug. 19, 1926. There must have been something very stimulating in Mr. Turner's recent visit to New York to have caused his strange conclusions as to New York's building methods.

The "lightness or seeming flimsiness" of New York's steel construction is in accordance with a conservative building code and its performance through the years is entirely satisfactory and creditable. This "seeming flimsiness" of steel construction compared with the "less expensive and more substantial appearing concrete buildings of the West" is perfectly reasonable because structural steel, per unit of volume, is 3.2 times as heavy and 22.5 times as strong as concrete. Concrete *ought* to look more substantial but mere looks are not a reasonable criterion.

The actuarial survey of the mortality of modern office buildings in forty American cities shows that an inevitable obsolescence begins in twenty-eight years and that in many instances complete obsolescence obtains in much less time. Obsolescence is economic, not physical, and it is that which causes the useful and profitable life of anything to be shortened. Experience in demolishing concrete buildings in New York and elsewhere has shown it to approximate closely the cost of the original construction, and the sagacious investor selects a type of construction which is easily demolished and yields a valuable salvage, or one which is easily and cheaply converted for another occupancy.

The relative speed of construction throughout this country is entirely favorable to steel frames with concrete floors—Mr. Turner being otherwise impressed, notwithstanding. What relation he observes between building construction and bridge construction, as noted in his letter, is not clear to the writer.

New York City, Aug. 25, 1926. A. T. NORTH, A.I.A.

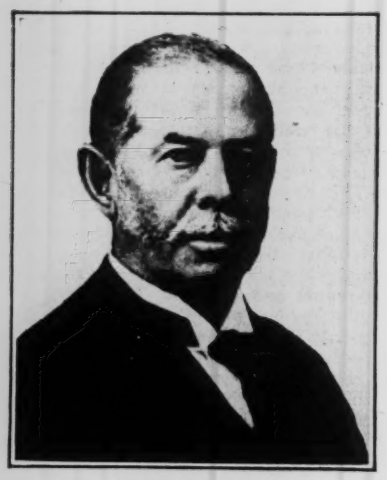
News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

William Hood, Railroad Engineer, Dies

Located and Built Many Difficult Sections of the Central and Southern Pacific Ry.

William Hood, one of the few remaining engineers of the days of bold pioneer railroad construction, died at San Francisco, Aug. 26, in the 80th year of his age. Mr. Hood had retired from active service in 1921 on the 54th



William Hood

anniversary of the day he began work with the Central Pacific as a rodman and after 38 consecutive years of service as chief engineer of the Central & Southern Pacific R.R.

William Hood was born at Concord, N. H., Feb. 4, 1846. When 16 years old he enlisted as a private in Co. A of the 46th Massachusetts Volunteers, served in the Civil War for two years, and after he was mustered out of service he went to Dartmouth College, where he was graduated with a degree of Bachelor of Science in 1867. At that time, the construction of the Central Pacific R.R. on the Pacific Coast was under way and he went out there to begin work as a rodman in a field party in May, 1867. The following year Mr. Hood became an assistant engineer of the same railroad and in 1872 went to the Southern Pacific as assistant engineer, becoming assistant chief engineer in 1875. This position he held until in 1883 he returned to the Central Pacific as chief assistant engineer, becoming chief engineer in October of that year. When the Southern Pacific System was formed he became chief engineer of the Southern Pacific Co. and remained as chief engineer of that company after the separation of the Southern and Central Pacific.

Many of the outstanding achievements in railroad location and construction on the Pacific Coast and in the Rocky Mountain region were conceived by William Hood and many of his original locations were so well made that they hardly have been changed today after more detailed studies of recent years. A few of his more outstanding accomplishments were the construction of the famous Tehachapi loop, the building of the Lucin cut-off across Great Salt Lake, the line across the Siskiyou Mountains, with its 18 crossings of the Sacramento River and 16 tunnels, and the completion of the line through the Carrisco Gorge to unite the Imperial Valley with San Diego.

Following his retirement, Dartmouth College awarded Mr. Hood the degree of Doctor of Science. Except for a lapse of 7 years from 1889 to 1896, Mr. Hood had been a member of the American Society of Civil Engineers for 50 years. He was one of the five honorary members of the San Francisco Engineers Club.

Engineering Fifty Years Ago

From *Engineering News*, September, 1876

CLEVELAND'S new Water Works tunnel has been completed, and water has been let in. Saturday morning a flag was hung out at the crib signifying that the gate had been opened and a full head of water is now entering, and the engines are pumping from it to the reservoir. This improvement is one of the most substantial of the city, and affords a sense of security in the matter of abundant water supply. The contractor, General A. A. Macdonell, has finished his work in a masterly manner and to the entire satisfaction of the Trustees. He did the work in a most remarkably short space of time, and yet did it well. He built the lake tunnel and this with several other contracts has established his reputation as a responsible and competent engineer.

Railway Electrification at Montreal Proposed

Electrification of all railway lines in the city of Montreal, Quebec, is to be considered by the City Council at a meeting to be held in the near future, according to a report to the Department of Commerce. Proposed legislation which will be considered by the council will cover the electrification of both freight and passenger lines within the city limit and will require complete electrification of all lines similar to that which is now in progress at New York City.

WASHINGTON NOTES

COMPUTATIONS of the ventilation requirements of the Moffat tunnel are being made by G. E. McElroy, of the staff of the Bureau of Mines. Friction factor tests are to be made in the near future.

The Bureau also will co-operate with the California State Industrial Accident Commission in work in the East Bay water project tunnels to determine if carbon monoxide, in dangerous quantities is generated in connection with welding operations. B. O. Pickard and C. G. Maier, of the Bureau's engineering staff, have been assigned to this work.

A CONFERENCE on the scope of the proposed work to prevent further recession of the crest of Niagara Falls was held recently by the representatives of the two interested governments. Major-Gen. Edgar Jadwin represented the United States Government and Col. O. M. Biggar, the Canadian Government. The United States originally proposed that the work be undertaken solely to preserve the scenic beauty of the Falls, but the Canadian Government suggested that the matter of increasing the diversion of water be considered also. However, since the first proposal was made, there has been an improvement in the water power situation in Ontario, and it is hoped that this will lead to the elimination of the highly controversial question of water diversion and permit the matter to be dealt with from the viewpoint of preserving the Falls, a point upon which both governments are in agreement.

THAT the teredo and other marine borers may have cycles of activity is one of the assumptions reached by the Chemical Warfare Service to explain its greatly extended activities. The fact that these borers have appeared in Pacific waters, where they were unknown before, may be explained, it is declared, by the increased salinity of the water, due to the decreased volume of discharge from fresh water streams caused by the deficiency of rainfall in recent years.

The Chemical Warfare Service has found eleven chemicals which, when added to creosote are effective in the control of marine pests. Some of the most desirable poisons for use in this work do not have the requisite degree of solubility. To be effective in the treatment of piling or other wood intended for use under water the poison must be slightly soluble. This eliminates substances not soluble in sea water and those which leach out too quickly.

A report on this subject has been made to the Smithsonian Institution.

Construction of Flood Channel at Colorado Springs Agreed Upon

Engineers representing the city of Colorado Springs, the Rock Island and Santa Fe Railroad, after various surveys have agreed on a $75,000 concrete lined drainage canal through the Rock Island cut north of the city to take care of flood waters. The water at various times has washed out the railroad company's tracks and has done damage in the city, but with the new channel the water will be carried to Monument Creek and Shook's Run.

Bids Called For on Subway Under East River at New York

On Aug. 31 the Board of Transportation of the City of New York called for bids on the construction of the 53rd St. route of the city's new subway system, a line to extend from Broadway and 8th Avenue under 53rd St. and the East River to Nott and East Aves., Long Island City, a distance of 2.15 miles. On account of the magnitude of the undertaking, the work is to be divided into three sections, the first to extend from 8th to 5th Ave., the second from 5th Ave. to 2nd Ave., and the third, the section from 2nd Ave. under the East River and Welfare (Blackwells) Island to Long Island City. Bids for the first two sections are to be received on Oct. 1 and for the river section, on Oct. 15.

The subway will pass under the Interborough subway at Broadway, the Brooklyn-Manhattan subway at 7th Ave., the New York Central tracks in Park Ave., and the Interborough subway at Lexington Ave. It will be 55 ft. below street level where it crosses under the New York Central tracks and 78 ft. below the surface at the ventilating shafts on Blackwells Island.

California Section A.W.W.A. Meets at San Diego in October

Besides some ten formal papers and a number of five-minute discussions at the annual convention of the California Section of the American Water Works Association, to be held at San Diego, Oct. 28-30, there will be an informal dinner on the first day, followed by an address on the Colorado River project for an additional water supply for the city of Los Angeles, to be given by William Mulholland, chief engineer of the Department of Public Service of Los Angeles. On the second day, a dinner dance will be given by manufacturers. Saturday, the third day, will be devoted to an automobile trip to the Lower Otay Dam and other points of interest in the San Diego waterworks system with luncheon served en route by the city of San Diego.

Among the formal papers are: "The Biological Control of Impounding Reservoirs," by Dr. Carl Wilson, director of biological laboratory, Bureau of Water-Works and Supply, City of Los Angeles; "Water Meter Maintenance Methods," by J. H. Fagg, district manager, Pacific Gas & Electric, San Joaquin Division; "Corrosion Problems," by E. B. Stewart, electrolysis engineer, East Bay Water Co., Oakland; "The Duty of Water in General Municipal Uses," by Charles Lee, consulting engineer, San Francisco; "Iodine in Drinking Water," by C. G. Gillespie, director, Bureau of Sanitary Engineering, California Board of Health, Berkeley.

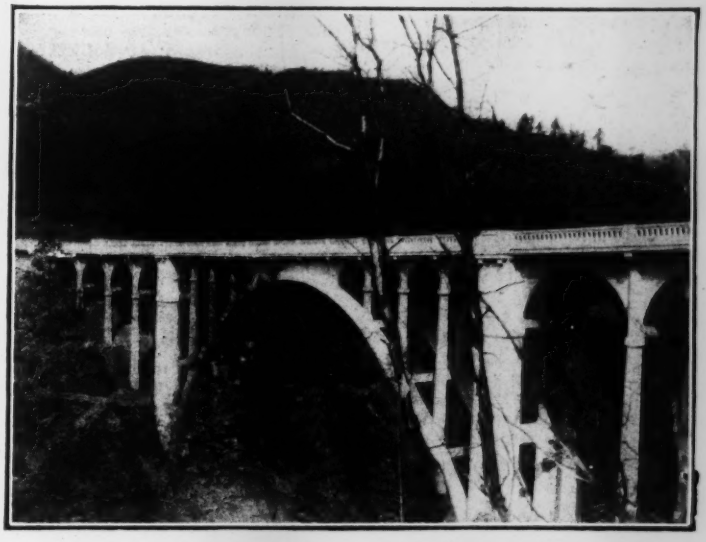
Highway Safety to Be Discussed At Meeting in Los Angeles

Methods of safeguarding highway crossings will be discussed at the convention of the Signal Section, American Railway Association, to be held in Los Angeles, Cal., beginning Sept. 7. The Signal Section has had the subject of highway crossing protecting under consideration for some time and has agreed to make the flashing light and the wig-wag type of signal the recommended practice for highway crossing signals to denote the approach of trains. So far, twenty states have approved the Signal Section's recommendations for uniform highway crossing signals.

In the railway field, the Signal Section will discuss the greater use of automatic signals in order to increase safety and track capacity, also revise specifications for the installation of electric interlocking systems.

Another Chicago Subway Plan

The latest addition to the long list of projects for rapid transit subways in Chicago is that of a citizens' advisory committee appointed by the City Council's committee on local transportation. This plan proposes two subways, one for elevated railway trains and the other for street cars. The first of these, giving a north-south rapid transit route through the business district, would be a high-level subway running east on Chicago Ave. from Franklin St. and then south on State St. to Roosevelt Road (12th St.), with four tracks for part of the distance. The second subway would form a double-track low-level loop on Washington St., Michigan Ave. and Jackson St., connecting with the existing tunnels under the river at Washington and VanBuren Sts. The estimated cost is $23,950,000 for the north and south line and $12,450,000 for the loop line, a total of $36,400,000. It is suggested that the project can be financed largely by special assessments of adjacent property, the property in the central business district paying 65 per cent of the total and that in other sections paying from 20 to 2½ per cent. The same report recommends three extensions of the elevated railways. R. F. Kelker, Jr., was engineer for the advisory committee.



FIRST OF NEW BRIDGES ON PACIFIC HIGHWAY IN SACRAMENTO CANYON OPENED TO TRAFFIC

CHARLEY CREEK bridge, Shasta County, Calif., just opened to traffic; concrete two-rib arch 147 ft. long, 24-ft. roadway. It is one of a number of large concrete arches required in connection with the relocation of the Pacific highway through the Sacramento Canyon in Shasta County. The road at present runs around the edge of canyons with sharp and dangerous curves, and the new crossings will cut off the worst of the bends. Charley Creek bridge eliminates a half mile of road; besides making travel safer it avoids the necessity of widening and paving the road around the bend. Similar bridges are to be built across Doney Creek and Dog Creek, the latter to have a 234-ft. arch, the largest concrete arch span in California. Bordwell & Zimmerman, of Napa, Calif., were contractors for the Charley Creek bridge and are also building the Doney Creek bridge. The designs were prepared by the state highway commission.

RANDOM LINES

Confessions of a Draftsman

By Elldee

Before Ben Franklin flew his kite upon the far famed Isle of Wight and from his observations deep cleared up the mystery of sleep—when we were young and still a fright, it grieves us greatly to indite, we climbed upon a drafting stool, picked up the drawing stick and rule and jerked the T-square into place and started on life's dreary race to snare the wherewithal for cheese and neckties, buns and beeveedees.

Full many years have passed since then, and still we're hustling for the yen, pursuing contours o'er the leas with wheezy flues and rusty knees and silver spots above our ears, oft dreaming thru our misty tears of that bright day somewhere ahead when we'll have saved sufficient lead to buy an acre and a hen and cozy, vine-bespangled den out where the skies are soft and pink and birds sing on the rinkeydink.

But, beef stew's twice as high today and we've not had a raise in pay since King Tut with a muttered moan gave up the ghost and turned to stone!

"Art Gumm, if you don't watch your step—get busy—pronto show some pep, complete that chicken coop side view on which you've loafed a month or two, I'll fire you, so help me Pete!"—Well, au revoir, it's time to eat.

* * *

New Nomenclature

Sir—Hydraulic engineers who wish to use the most up-to-date methods will be interested in the following novel method of determining the yield of a well pumped by air lift which was recently received in reply to a request for data on pumpage.

"We draw 2½ gallons a gush and one gush every five seconds equals 12 gushes per minute and in one hour it would equal 720 gushes per hour. At 2½ gallons per gush we have 1,800 gallons per hour, at 12 hours a day we have 21,600 gallons per day."

* * *

Approaching the 200 Mark

(192) "*Tramrail Engineers* are material moving specialists" — Cleveland Crane & Engineering Co.

(193) *Real Estate Sales Engineer*—One is wanted by the Point Pelee Land Co., Inc., of Detroit, Mich. A fine opportunity for an engineer out of a job—and low on conscience.

San Gabriel Dam Advanced One More Step

The Federal Power Commission has given the Los Angeles Flood Control Commission the right to build a dam across the San Gabriel River at the Forks on certain lands held under the jurisdiction of the commission as land applied for for the production of water power. The commission reserves the right to control water power which may be developed later, either by the flood control district or with its permission. This is the second step toward the construction of the large flood control dam at this site, as planned by the Los Angeles County Flood Control District, and opposition to which has arisen in the city of Pasadena. It still remains the question of the right-of-way for the construction of a railway designed to carry material, supplies and men to the dam site. Authorization for this will have to come from the Secretary of Agriculture, as this right-of-way is under the control of the Power Service. Secretary Jardine is expected to rule on his phase of the situation within a month.

Buffalo to Build New City Hall on Own Property

The Buffalo City council has voted down the proposal to buy additional land on the west side of Niagara Square for the new city hall. This was due to the property owners asking $766,650 for land assessed at $414,270. Plans now will be carried out to erect buildings on the two blocks owned by the city.

Notice has already been served to tenants upon these two blocks for vacating that the work may at once proceed.

This new improvement will be a building of sixteen stories in height with a cost estimated at $2,000,000 although definite figures can not be given until the plans are ready.

Heavy Rainfall at Detroit, Mich.

A total of 3.09 in. of rain fell in 1 hr. and 4.51 in 5 hr. at Detroit, Mich., on Aug. 17, with a maximum intensity of 10.3 in. for 5 min., 4.88 in. for 30, and 3.09 in. for 60 min. Further details and comparisons of intensity rates for the Detroit 10-yr. design curve and the 30-yr. intensity curve are given in the accompanying table, supplied to this journal by Perry A. Fellows, city engineer. For all 16 of the periods shown in the table the Aug. 17 intensities exceeded the two intensity curve rates mentioned. Some accumulated totals for a shorter storm in Manhattan and in Brooklyn Boroughs, New York City on Aug. 12, were given in these columns for Aug. 26, p. 357.

Major Dabney Fatally Burned In His Home at Memphis

A. L. Dabney, his wife and seven-year old adopted daughter, were fatally burned in a fire which occurred in their home at Memphis, Tenn., about midnight, August 22. Major and Mrs. Dabney received the burns which resulted in their death while attempting to save the child from a fire which broke out in the sleeping porch in which she was sleeping.

Major Dabney has long been prominent among engineers in the Mississippi Valley for his work on levee construction and for his contributions to engineering literature on the same subject. He was a native of Vicksburg, Miss., a son of Thomas G. Dabney, a pioneer in the river control field. In 1892 he graduated in civil engineering from Washington and Lee University. Previous to graduation young Dabney had been employed as a rodman and as an instrument man on railroad location and levee construction and during his college course he spent his summer vacations on river work both with the U. S. survey party and with the Delta Levee District. Following graduation he became U. S. assistant engineer in charge of all U. S. work on the lower White River Levee District and in May, 1897, became assistant chief engineer of the Delta Levee District at Yazoo, Miss. Five years later he resigned to enter into private practice, later for a time being employed on the construction and design of sewage disposal plants for the firm of Hering & Fuller of New York. In 1908 he returned to the South to take charge of engineering work for the Tallahatchie Drainage District which position he held until in 1912 he opened an office as a consulting engineer at Memphis. During the war Major Dabney was commissioned in the Engineer Corps and was first in charge of sanitary work on construction of the cantonments at Chickamauga Park, and later on similar work at Muscle Shoals, Ala. However, on account of ill health, he resigned his commission and returned to Memphis.

Contract Let for Large Wharf

The Anglo-Newfoundland Pulp & Paper Company of Cornerbrook, Newfoundland, a concern which is subsidized by the British and Newfoundland governments and the G. W. Armstrong-Whitworth Company, has just granted a contract to the T. E. Rousseau Company, Limited, of Quebec, for the construction of a wharf and warehouses, at a cost of approximately $250,000, at Cornerbrook. The work will commence immediately and the contract calls for its completion by November 1st next.

Rainfall at Detroit, Mich., for the Storm of Aug. 17, 1926

Maximum accumulated amounts; also corresponding hourly intensities as compared with the 10-year design curve and the 30-year curve for Detroit.

Interval Minutes	5	10	15	20	30	45	60	80	100	120	150	180	210	240	270	300
Maximum accumulated rainfall, in. storm 8-17-26	.86	1.40	1.86	2.11	2.44	2.59	3.09	3.54	3.79	3.86	4.09	4.12	4.38	4.43	4.49	4.51
Intensities, in. per hr., 8-17-26	10.30	8.40	7.44	6.34	4.88	3.46	3.09	2.66	2.28	1.93	1.64	1.37	1.25	1.11	1.03	.90
Design curve intensities 10-yr. storm	6.10	4.80	3.85	3.30	2.70	2.17	1.82	1.52	1.31	1.17	.98	.87	.77	.70	.63	.57
30 year curve intensities	8.04	5.40	4.32	3.75	3.05	2.58	2.30	2.01	1.74	1.51	1.20	1.02	.91	.85	.80	.75

Commerce Association Reports on Chicago Sanitary District

That the engineering work of the Sanitary District of Chicago is well done and that construction costs in general are reasonable, but that the District's great pay-roll expenditures for legal services and for maintenance and operation of plants (which latter item is outside of the engineering department) are open to severe criticism, are the summarized findings of an investigation by the Chicago Association of Commerce. As to contract prices, Maj. Gen. Harry Taylor, retired chief of engineers, U. S. Army, who assisted in the investigation, advocated wider advertising for bids. In reply, Mr. King, president of the District, says it had been the policy to give preference to Chicago contractors, but that in view of this report such work will be advertised in future in engineering papers whose circulation covers the United States, as well as in local papers. General Taylor criticises some of the contract prices as excessive and as representative of unbalanced bidding. As to inspectors on construction work, he points out that they are not appointed by the chief engineer nor on account of their qualifications, a system which throws a burden on the engineers in charge in order to secure good work.

High Degree of Sewage Treatment at Tenafly, N. J.

Bids for sewage disposal works for Tenafly, N. J., which will provide for an unusually high degree of sewage treatment, are to be received on Sept. 13. The plant will combine the activated-sludge process, sand filtration and chlorination. The activated-sludge process was decided on, this journal is informed by J. C. Harding, of Fuller & McClintock, consulting engineers for the plant, because very little land was available in practically the only part of the borough where treatment works could be installed and also because nearby residences made necessary a type of plant that would produce a minimum of fly or odor nuisance. Inasmuch as the sewage works are to be located in the watershed of Tenakill Brook, about 4½ miles above the upper end of the Hackensack Water Co.'s reservoir at New Milford, it was deemed advisable to chlorinate the sewage after treatment by the activated-sludge process. As a further precaution urged by the State Board of Health, sand filters were included in the design.

Improvements Made to Jordan Hydro-Electric Project

The British Columbia Electric Railway Co., in pursuance of its policy of increasing the storage capacity of its Jordan River hydro-electric development, will carry out an extensive program extending over a period of years. The company is preparing to increase its storage capacity by 2,000,000 kw-hr. by enlarging the dam.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.: Annual Meeting, Providence, R. I., Sept. 14-17, 1926.

INTERNATIONAL CITY MANAGERS' ASSOCIATION, Lawrence, Kansas: Annual Convention, Colorado Springs, Colo., Sept. 21-23, 1926.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, N. Y.: Annual Convention, Philadelphia, Pa., October 4-9, 1926.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York City: Annual Meeting, Buffalo, N. Y., Oct. 11-14, 1926.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington, D. C.: Annual Convention, Pinehurst, N. C., Nov. 8-12, 1926.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Louis, Mo.: Annual Meeting, Washington, D. C., Nov. 8-12, 1926.

THE ASPHALT ASSOCIATION, New York City: Annual Meeting, Washington, D. C., Nov. 8-12, 1926.

The North Carolina Section of the Amercan Water Works Association at annual meeting at Raleigh elected as its officers for the coming year: President, C. M. Grantham, city manager of Goldsboro; vice-president, C. E. Rhyne, superintendent of water and lights, Gastonia; and secretary, H. G. Baity, of the State Board of Health.

The Southwest Water Works Association will hold its 14th annual convention in Shreveport, La., Oct. 11 to 15, 1926.

Personal Notes

COL. WM. B. LADUE, until recently district engineer, Third New York District and engineer, Second Corps Area, has been appointed division engineer, Northeast Division, U. S. Army, with headquarters at New York, vice Col. Herbert Deakyne whose promotion to the rank of brigadier-general, assistant chief of engineers, was announced recently. Previous to his coming to the Third New York District, Col. Ladue was district engineer of the Philadelphia district. During the war he commanded the 207th Engineers in France.

LT. COL. ROBERT R. RALSTON, until recently instructor, the Command and General Staff School, Fort Leavenworth, Kans., has been appointed district engineer, Third New York District, vice Colonel Ladue.

ALEXANDER W. GRAHAM, formerly a highway engineer in Missouri, was appointed district factory manager for the Caterpillar Tractor Co. in charge of Missouri, Kansas, Oklahoma, Texas and Tennessee. Mr. Graham will retain his present offices in the Railway Exchange Building, Chicago.

Mr. Graham was engaged in road building in Missouri for five years, ending in 1922. Since then he has been factory representative of several road building equipment companies.

L. E. FISCHER, of St. Louis, Mo., has been appointed vice-president in charge of operation of the North American Light & Power Co. serving many communities in Illinois, Iowa, Missouri, Kansas and Nebraska. Mr. Fischer is a civil engineering graduate of the University of Illinois, was assistant city engineer at Kewanee and city engineer at Paris, Ill., and later general manager of the Illinois Traction System, a comprehensive public utility organization.

EDGAR S. BLOOM, a vice-president of the American Telephone & Telegraph Co., has been elected president of the Western Electric Co., succeeding CHARLES G. DUBOIS, who continues with the company as chairman of the board of directors. Mr. Bloom is a graduate of the engineering department of the University of Pennsylvania.

HENRY C. IRONS, JR., WILLIAM G. IRONS, 2ND, A. PEARSON HOOVER and ARTHUR L. OTTERSON announce the formation of Irons and Hoover, Inc., Engineers and Constructors, successors to Henry C. Irons & Sons, Inc., 101 Park Ave., New York City.

A. S. BELL has been appointed county highway engineer for Ohio County, West Virginia, with headquarters at Wheeling.

Obituary

PAUL E. MERCIER, consulting engineer, Montreal, who in 1915 was city engineer of Montreal and since 1918 consulting engineer to the city, dropped dead Aug. 24 while engaged in survey work for the St. Regis Paper Co., at Trinity River in Saguenay County, being 49 years of age. Mr. Mercier was born at St. Hyacinthe and took his engineering course at the Polytechnic School, Montreal. He soon went to the Yukon where he was for a time district engineer of Yukon territory. He was also assistant engineer of the Dominion Department of Public Works, district engineer of Quebec, and engineer in charge of a section of the Canadian National Rys. He was the author of numerous technical books, and a member of many engineering societies in Canada and the United States.

WALTER J. SMITH, formerly assistant engineer of the Pueblo Conservancy District, Colorado, and recently appointed as engineer and special assistant to the Board of Appraisers of the Middle Rio Grande Conservancy District, at Albuquerque, N. M., was killed instantly Aug. 21, when the automobile in which he was driving was struck by a train at a crossing near Berlin, N. M. Mrs. Smith who was riding with him was so seriously injured that she died the next day.

Construction Equipment and Materials

A SECTION DEVOTED TO WHAT THE MANUFACTURER IS DOING FOR THE ENGINEER AND CONTRACTOR

Machine-Made vs. Hand-Made Drill Steel Bits

Speed in Forming Machine-Worked Bits Only One of Many Advantages Claimed—Others Named

PUTTING in a drill hole while the first of a series of interdependent operations on all rock excavation and rock road-building work is also the one upon which the other operations are dependent. For this reason, the drilling rounds should be put in on schedule time and in a recent statement the Ingersoll-Rand Co. names the reasons why machine-made drill-steel bits contribute more to the necessary efficiency on the job than do bits hammered into shape by hand. The Ingersoll-Rand Co. is authority for the following statements:

Observations at many sharpening shops in various parts of the world have shown that one man with a drill-steel sharpener can form or sharpen from three to ten times as many bits as two men sharpening by hand. But speed in forming the bit is not so important as speed in drilling. There are several reasons why a machine-made bit will drill faster than a hand-made bit: (1) The cutting edge of the machine-made bit is sharp and concentric; (2) the material back of it is dense, having been compacted by many powerful hammer blows; (3) the angle, of which the cutting edge is the apex, is correctly made so as to give the proper chipping blow; (4) the clearance space between the wings of a machine-made bit is sufficiently wide to give ample room for rock cuttings to pass; (5) because the sharpener made bit is symmetrical, there is less likelihood of holes "rifling." All the foregoing reasons are important, but the principal reason for the greater drilling speed of a machine-made bit is that it does not have to cut so much rock.

In practice, the gage tolerance on hand-made bits is seldom within ¼ in. Sharpener-made bits, on the other hand, can be gaged to ⅛ in. The difference in total diameter when drilling a 10-ft. hole means that the succeeding bit of the larger diameter must cut through just so much more rock in effecting its desired penetration. It is claimed that hand-made bits drill about 50 per cent more rock than do machine-made bits.

Because of the avoidance of rifled holes and because of ample passage for cuttings between the wings and the bit, the steel is not so likely to stick in the hole, thus causing much loss of time in removing it. When steel is sharp it cuts the rock. When it is dull it strikes the rock an ineffectual blow. The energy of this ineffectual blow, which is transmitted through the drill steel, sometimes breaks the steel or even the rock drill itself. A sharpener-made steel retains its cutting edge and gage much longer, thus nearly twice as much footage is claimed with such steel as with a hand-made bit. When necessary to make an entirely new bit by hand, the operation takes about six times as long as it would to put a new edge on an old but unbroken bit. When the work is done by the machine, upsetting the broken steel and forming a new bit takes only twice as long as it would to resharpen an unbroken bit.

Emphasis should be placed always on seeing to it that the entire drill steel is in proper condition. That is to say, the shank is just as important as the bit, and this fact should not be lost sight of, no matter whether the steel is made up by hand or by machine. Shanks made on a sharpener are true in shape and in size. Therefore, they utilize the maximum power of the drill. On the other hand, shanks made by hand may vary greatly in these particulars. If the shanks are even a little too long, the piston of the drill cannot travel its full length, and thus cannot develop its full power before hitting the steel. Conversely, if the shank is short, much of the power of the piston's blow will be absorbed by the fronthead and the springs, instead of being delivered to the drill steel.

Airway Lighting Units Ordered by Commerce Department

The purchase of ninety 24-in. revolving lights to facilitate night flying on seven established airways has recently been authorized by William P. MacCracken, Jr., the newly appointed aviation secretary of the U. S. Department of Commerce. The lights will have a normal visibility of 50 miles during favorable weather and will be placed 10 miles apart. Complete lighting of the New York to Boston route is provided, while the dark ends of the following routes will be lighted at the earliest opportunity: St. Louis to Chicago; Dallas to Chicago; Salt Lake City to Los Angeles; Pasco to Elko; Chicago to Minneapolis; and Cheyenne to Pueblo.

Officials of the Bureau of Lighthouses will have charge of the airway lighting work and the preliminary work of erecting towers and providing for other necessary equipment will be undertaken at once. Wherever power is locally available, it will be used. In other cases gasoline generators will be provided which will be looked after by caretakers, probably on a part-time basis. Steps will also be taken to provide for the lighting of the boundaries of emergency landing fields, usually about 40 acres in extent, to be laid out at approximately 30 mile intervals along established airways. The plan is to have lights completely circle the emergency fields at intervals of about 300 ft. All of the routes above indicated are now being flown by commercial companies which have air-mail contracts. It is said that these companies are also in a position to carry passengers and freight.

Booklet Reminds Visitors of Trip Through Plant

Last June, a group of Austrian manufacturers touring the United States visited the Newport Rolling Mill Co. at Newport, Ky. This company, wishing to commemorate the event and at the same time give the visitors some sort of a souvenir that they would appreciate, prepared a booklet which was mailed to each one after he had returned home. Extra fine printing and paper are used, but other than this the booklet is very simple. One page is a reproduction of the register upon which each visitor had signed his name. Opposite this is a photograph of the visitors taken at the plant, beneath which is the name of each man, his company and address. The booklet is entitled "A Reminder of Your Visit to the Newport Rolling Mill Company" and concludes with a statement of appreciation of the visit the Austrians made.

Business Notes

ROSS HEATER & MFG. CO., INC., Buffalo, announces that Harold M. Graham and Ross H. Rathbun have recently joined the organization in the capacities of chief engineer and sales manager, respectively. Mr. Graham has formerly been with the Westinghouse Electric & Mfg. Co. and the Elliott Co., the latter of which he left to take his present position. Mr. Rathbun leaves the Westinghouse Electric & Mfg. Co. with whom he has been associated since 1916, having been in charge of the central station department with headquarters at Cleveland, Ohio.

CHICAGO PNEUMATIC TOOL CO., New York, will open, on Oct. 1, its new building located on Iron St. near 37th St., Chicago. The building is the new home of the Chicago sales and service branch. The building has been designed especially to increase the company's service both to its Chicago customers and to the customers of adjacent branches.

CHAIN BELT CO., Milwaukee, Wis., has appointed Peter Verhey its southern district manager. Mr. Verhey's headquarters will be in Atlanta, Ga. Prior to 1919 he was connected with J. F. Casey at Pittsburgh and J. I. Green & Co. at Chicago. He later went into the contracting business for himself, building roads during 1923 and 1924 in Illinois.

CONSOLIDATED EXPANDED METAL CO., located for 25 years at Braddock, Pa., is moving to its newly erected plant at Beach Bottom, W. Va. The company believes this new plant is the largest

and best equipped expanded metal mill in the country. It will be devoted exclusively to manufacturing metal lath, concrete reinforcement, and analogous products. The new offices of the company will be located at Wheeling, W. Va., in the Steelcrete Building.

McMYLER-INTERSTATE Co., Cleveland, Ohio, has appointed three new distributors in the west and southwest. W. H. Worden Co., San Francisco, for California, Arizona and Nevada. C. F. Wolfradt, formerly Pacific Coast branch manager for the McMyler-Interstate Co., became affiliated with the Worden Co. Aug. 1. The Holfius Steel & Equipment Co., Seattle, has been appointed distributor in the states of Washington, Oregon, and Idaho and Thurman G. Frazee, Houston, Tex., for the state of Texas.

New Developments

Steel Pipe Centrifugally Lined With Concrete Available

The practice of centrifugally lining steel pipe with concrete has been followed in Europe for some years and is now being introduced into the United States under the direction of the East Jersey Pipe Co., New York City, and the M. W. Kellogg Co., Jersey City, N. J. The same process of manufacture as has previously been used will be followed, but pipe in 30-ft. lengths can be made by new equipment that the companies have developed. Such long lengths of pipe have not heretofore been possible. Pipe sizes in diameters up to and including 72 in. are available.

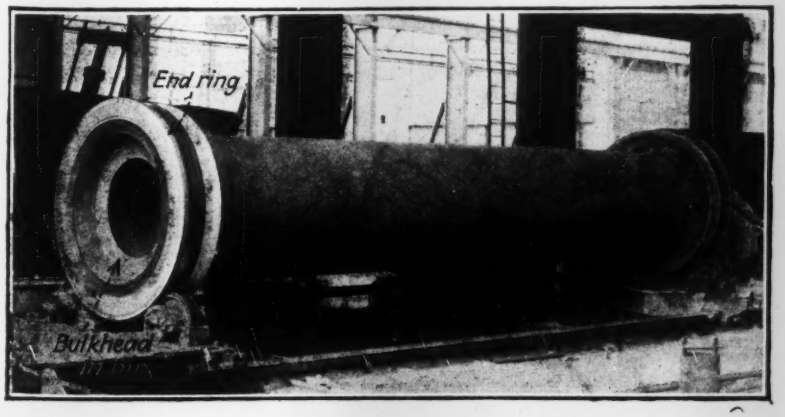
In the manufacturing process, the pipe is assembled with end rings, running on the surface of the machined runner wheels of the spinning machine. It is especially essential that the pipe run absolutely true and without vibration. While the concrete is being poured, the pipe revolves just fast enough to carry the material around and owing to its plasticity the concrete mixture soon distributes itself evenly inside the pipe. As soon as this has taken place, the speed is increased to the optimum. Up to this time there has been little relative movement of the particles, but as the speed increases the larger and heavier particles begin to move outward, leaving the finer materials to form the smooth bore of the pipe.

On the first spin the pipe is rotated until the concrete is said to be set, when the pipe is stopped. The excess water falls to the bottom and is swept out together with a little mud and any foreign matter. The pipe is then revolved again and a polishing bar passed through to remove any small irregularities. Finally, spinning is continued a minute or two to dry the inside of the pipe. The setting of the lining is quite distinct from what is usually described as the setting of cement. The latter is a chemical action, while it is believed that the setting of the cement in the pipe is almost, if not entirely, a physical effect.

The correct proportioning of the mixture is very important in order to prevent any porosity and to insure economy in cement. The mix must be wet enough to allow the materials to sort themselves out so as to form a true cylindrical internal surface. The excess water that is removed by the spinning process is said to remove only a very small amount of cement.

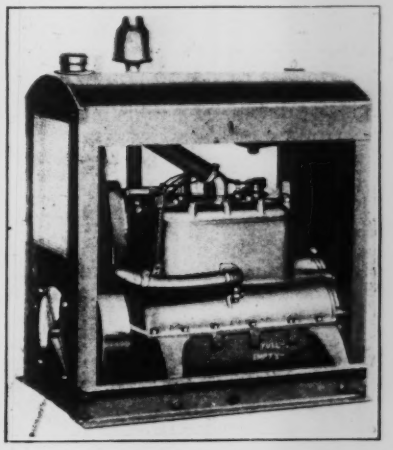
The important advantages claimed for the pipe are resistance to corrosion and to incrustation caused by certain acidic and mineral waters, and ability to withstand atmospheric temperatures without serious effect upon the concrete lining. The concrete lining also gives an increase in the strength of the pipe to resist external pressure. All the sand used in the manufacture of centrifugal concrete is washed clean and carefully selected, and each supply of material is sampled and tested in the company's laboratory from which analysis charts of mechanical tests are prepared. These are compared with a maximum density curve and the measuring of the proportional quantities of materials is adjusted accordingly.

Following is a list of the principal contracts that have used concrete-lined pipe in Europe: Birmingham Corp. Water-works, 1¼ miles of 62 in. diam., Cardiff Corp Water-works, 30 miles of 31-in. to 24-in. diam; Aberdeen, 15 miles of 40-in. diam.; Taf Fecham Water Board, 15 miles of 19 to 37 in. diam. In addition to these contracts, two other contracts are nearing completion: Capetown water-works, consisting of 30 miles of 33-in. diam., the steel pipe being manufactured in Germany and lined in Capetown; Singapore, 20 miles of 30- to 39-in. diameter, the steel pipe being made in Great Britain and lined at the site.



New Four-Cylinder Engine Develops 10-12 Hp.

A four-cylinder engine designed especially to fill the requirements for an engine not met by its two and four-cylinder heavy-duty types has just been announced by the Le Roi Co., Milwaukee, Wis. The engine develops 10 to 12 hp. While this is some 4 hp. more than the two-cylinder engine, its compactness is said to lend itself to installations where two cylinders have been used. In rounding out its line of gasoline engines, the company also brought out a one cylinder engine which develops 5 hp. With these two models, the company's line of gasoline power units now contains sizes ranging from 3 to 15 hp.



Concrete Mixer Water Supply Systems Confused

In these pages last week, in an article describing the new water system for the 27-E concrete mixer manufactured by the Koehring Co., Milwaukee, mention was made of tests on it as reported in *Engineering News-Record*, June 3, 1926, page 916. This was in error, as the tests reported and referred to were made on the new water control system used on the Rex 27-E paver manufactured by the Chain Belt Co., Milwaukee.

New Publications

Blowers and Fans — BUFFALO FORGE Co., Buffalo, N. Y., issued recently two new bulletins. Catalog 475 being on fans for use in ventilating small rooms, for exhausting gases, for supplying air, for combustion of oil in house heating units, for blowing air into generators and motors for cooling, etc. The second bulletin describes its type FB electric blower giving sizes and all operating information.

Engineering News-Record Statistics of the Construction Industry

Sept. 2, 1926 — *in the United States* — Vol. 97, No. 10

Engineering News-Record CONSTRUCTION COST Index Number (1913 = 100)

MONTHLY

January, 1925 to Date

September, 1926	**208.30**
August, 1926	208.30
September, 1925	202.10
Peak, June, 1920	273.80
1913	100.00

1925

Jan.	210.40	May	207.20	Sept.	202 10
Feb.	209.70	June	204.60	Oct.	205.35
March	210.20	July	204.60	Nov.	205.95
April	209.55	August	204.60	Dec.	205.95

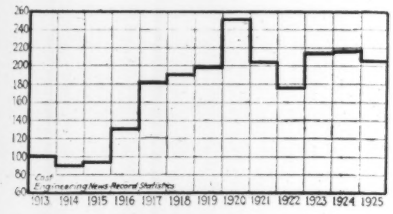
1926

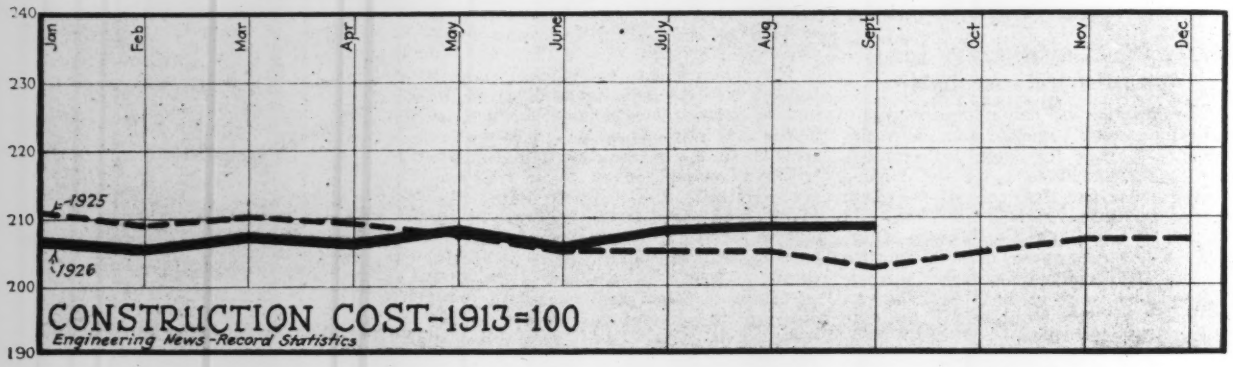
Jan.	207.15	Mar.	207.65	May	207.30
Feb.	206 55	April	207 05	June	204.80
		July	207.80		

ENGINEERING NEWS-RECORD'S Construction Cost Index Number is unchanged from the August level. Materials prices hold despite foreign competition in iron, steel, glass, cement, and brick. The average rate for common laborers is 55½c. per hr. for the entire country as compared with the same rate one month ago and 53c. at this time last year. Thus, general construction cost is 3 per cent above September, 1925, 24 per cent under the peak and 108 per cent above the 1913 level.

YEARLY

1913 to 1925





Engineering News-Record CONSTRUCTION VOLUME Index Number (1913 = 100)

MONTHLY

January, 1925 to August, 1926

August, 1926	**252**
July, 1926	248
August, 1925	266
Peak, August, 1925	266
1913	100

1925

January	141	May	209	September	262
February	145	June	214	October	233
March	161	July	178	November	194
April	211	August	266	December	206

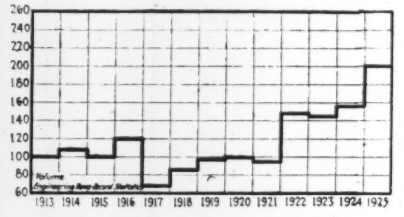
1926

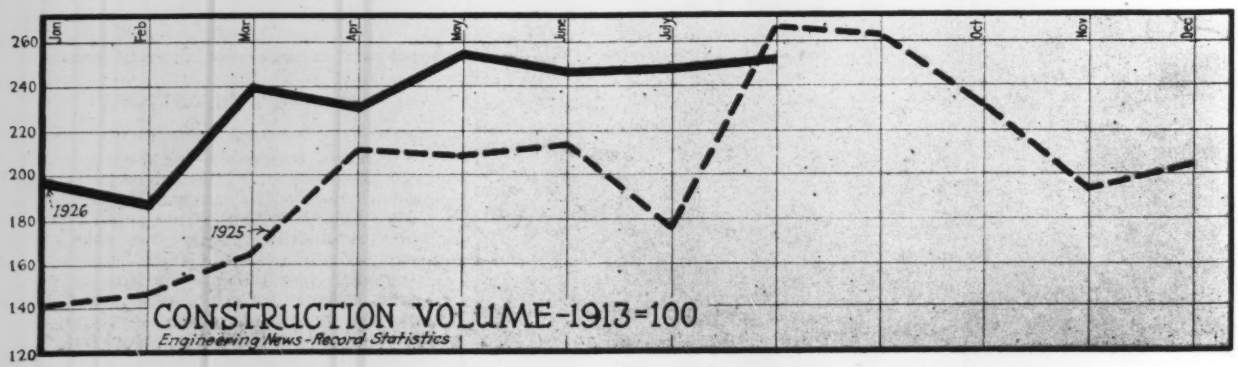
Jan.	198	Mar.	240	May	254
Feb.	187	April	233	June	246

ENGINEERING NEWS-RECORD'S Construction Volume Index Number is 252 for the month of August, and 201 for the whole of 1925, as against 100 for 1913. This means that the actual volume of contract letting in 1925 (not the mere money-value of the contracts let that year) is 101 per cent above the volume for 1913. The monthly volume number, 252 for August, 1926, contains the increment of construction and indicates the rate at which contracts are being let as compared with 1913 awards.

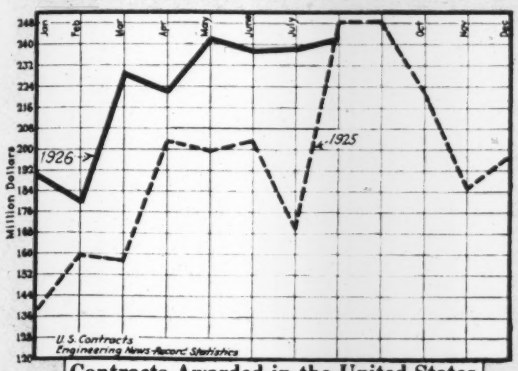
YEARLY

1913 to 1925

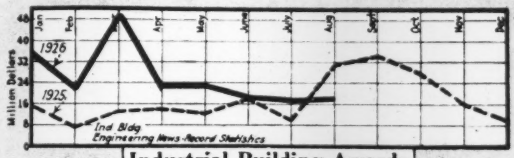




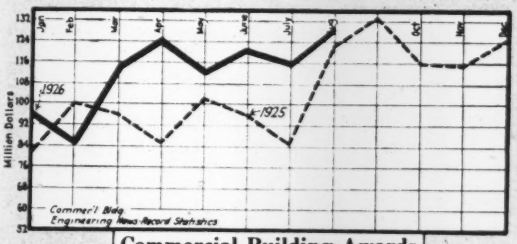
Monthly Statistics of the Construction Industry



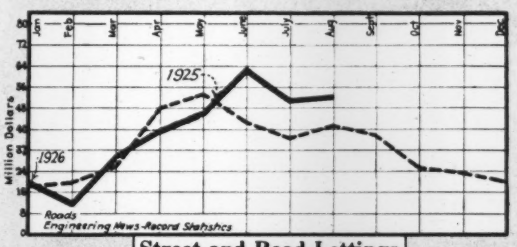
Contracts Awarded in the United States
Reported in E. N.-R.



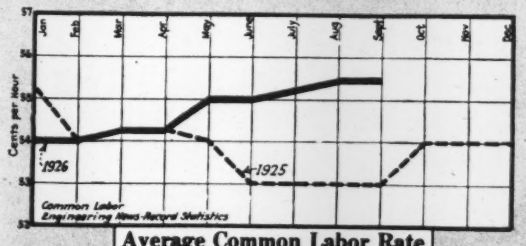
Industrial Building Awards
$40,000 and Over



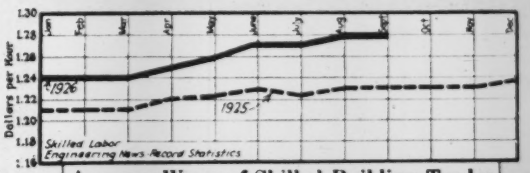
Commercial Building Awards
$150,000 and Over



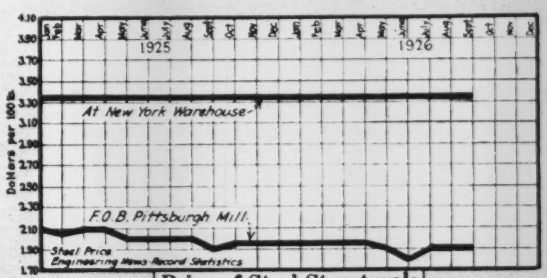
Street and Road Lettings
$25,000 and Over



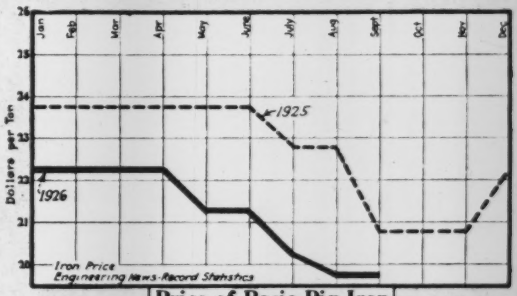
Average Common Labor Rate
Pick and Shovel Men



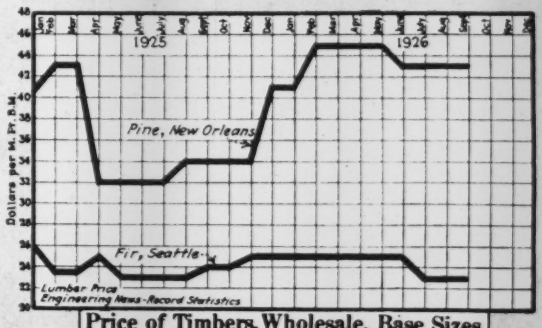
Average Wage of Skilled Building Trades
Bricklayers, Carpenters and Steel Erectors



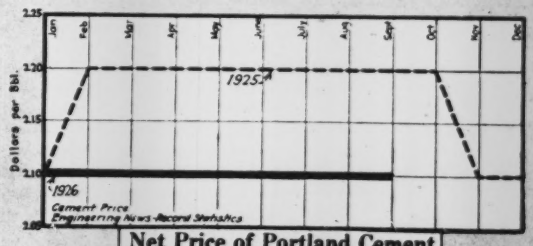
Price of Steel Structurals
Shapes 3-In.; Plates ¼-In.



Price of Basic Pig Iron
F.o.b. Pittsburgh

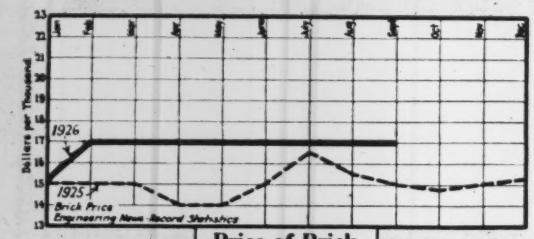


Price of Timbers, Wholesale, Base Sizes
Car Lots to Contractors

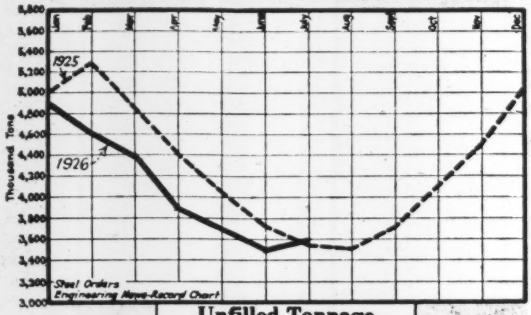


Net Price of Portland Cement
Car Lots, F.o.b. Chicago

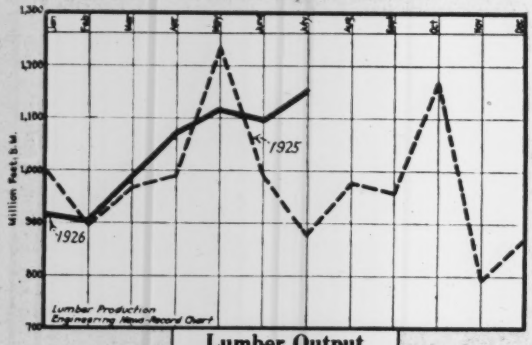
Monthly Statistics of the Construction Industry



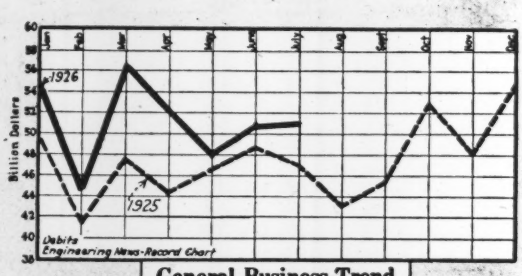
Price of Brick
At Dock, New York



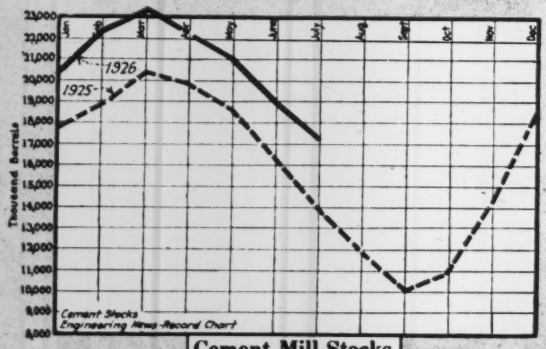
Unfilled Tonnage
On Books of U. S. Steel Corp.



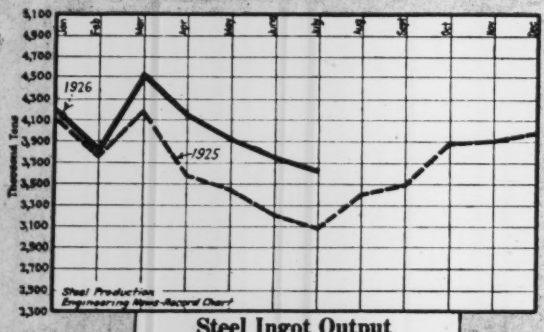
Lumber Output
Nat. Lumber Mfrs. Assn.



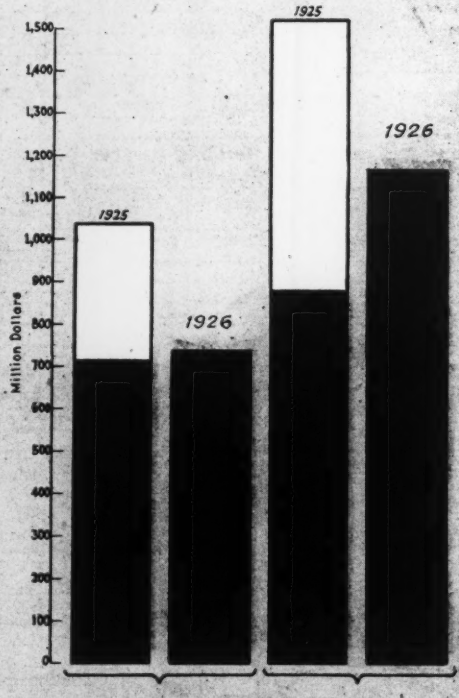
General Business Trend
Bank Debits—Federal Reserve



Cement Mill Stocks
Bureau of Mines



Steel Ingot Output
Gross Tons; Am. Iron and Steel Inst.



Public—Contracts—Private
Jan. 1 to date
Reported by E. N.-R.

Buildings and Other Construction, Projected and Awarded, Jan. 1 to Sept. 1, Ahead of Same Period Last Year

August Gained Heavily in Bridge Lettings, Federal Government and Excavating Work

ENGINEERING construction contracts awarded throughout the entire country during August, reached a total value but slightly under that of the same month last year. August, 1925 was the heaviest single month on record and the fact that this year's probable peak came very close to it, argues for the expectation of a 1926 total practically as heavy as that of last year.

The term engineering construction is taken to mean all water-works, excavating, drainage, irrigation, levee, river or harbor jobs of $15,000 and over; other public works at a minimum of $25,000; industrial buildings valued at $40,000 and up; commercial, educational, religious and other buildings at $150,000 or above.

At the minimum mentioned for each class, the cumulative total, Jan. 1 to Sept. 1, 1926, was $1,189,475,000 for buildings and $712,647,000 for construction other than buildings. In the case of the former the gain was 24 per cent, compared with the same months last year; in the latter, 11 per cent.

Projects in the proposed stage, however, show indications of a lessening in buildings and a protracted gain in other forms of construction.

Proposed work, definitely reported as such, for the period Jan. 1, to Sept. 1, 1926, amounted to $2,138,123,000 in buildings alone and $1,600,853,000 in construction other than buildings. The buildings, in this case, gaining only 14 per cent, compared with the same period last year, while other construction increased 16 per cent.

August registered substantial gains in bridge lettings, and awards for Federal Government projects and excavating work. Activity was greatest in the Middle Atlantic section and the Far West. States that showed notable increases in contract letting during the last month were as follows: New York, the Carolinas, Florida, Mississippi, Kentucky, Minnesota, Iowa, the Dakotas, Montana, Nevada and California.

Actual volume of August contract letting, reduced to a 1913 cost basis, for the last fourteen years, is as follows:

1913	100	1918	111	1923	100
1914	118	1919	135	1924	162
1915	126	1920	86	1925	266
1916	130	1921	116	1926	252
1917	63	1922	137		

Money value of August contracts, at the minimum mentioned in each class, for the last fourteen years, is as follows:

1913	$37,570,000	1920	$91,799,000
1914	49,427,000	1921	100,783,000
1915	54,352,000	1922	147,588,000
1916	99,764,000	1923	128,157,000
1917	68,926,000	1924	158,385,000
1918	124,828,000	1925	249,231,000
1919	126,814,000	1926	243,016,000

Value of Contracts Let in the United States and Canada During August, 1926

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States	Jan. 1 to Date U.S.	Canada
Waterworks	$156,000	$718,000	$318,000	$1,130,000	$1,314,000	$1,039,000	$4,675,000	$39,301,000	$126,000
Sewers	340,000	1,324,000	306,000	1,857,000	1,850,000	1,091,000	6,768,000	61,761,000	220,000
Bridges	513,000	5,976,000	1,189,000	1,746,000	934,000	512,000	10,870,000	53,432,000	.....
Excavating, drainage, irrigation	1,094,000	824,000	.....	1,627,000	1,277,000	300,000	5,122,000	19,376,000	163,000
Sheets and roads	2,577,000	11,997,000	9,364,000	15,284,000	9,051,000	4,441,000	52,714,000	338,512,000	1,318,000
Industrial buildings	2,111,000	1,523,000	3,000,000	5,847,000	3,570,000	1,262,000	17,313,000	213,567,000	2,201,000
Commercial buildings	10,467,000	47,618,000	3,997,000	34,161,000	17,601,000	14,990,000	128,834,000	975,908,000	2,669,000
Federal Government	314,000	4,978,000	1,423,000	213,000	1,022,000	583,000	8,533,000	38,463,000	.....
Unclassified	405,000	1,690,000	170,000	3,205,000	1,774,000	943,000	8,187,000	158,802,000	747,000
August, 1926	$17,977,000	$76,648,000	$19,767,000	$65,070,000	$38,393,000	$25,161,000	$243,016,000	$1,902,122,000	$7,444,000
July, 1926	33,994,000	63,483,000	25,964,000	94,285,000	59,613,000	21,760,000	299,099,000	.....	16,477,000
August, 1925	16,367,000	104,281,000	23,252,000	47,349,000	45,699,000	12,283,000	249,231,000	.....	11,421,000
January 1 to date, 1926	155,170,000	592,967,000	202,271,000	469,832,000	289,102,000	192,780,000	1,901,122,000	.....	86,842,000
January 1 to-date, 1925	130,969,000	570,316,000	132,599,000	287,440,000	287,020,000	191,755,000	1,600,099,000	.....	59,522,000

Labor Rates and Conditions Throughout the Country

Wage Schedules Remain at August Levels

STRIKES and wage controversies of major importance to the construction industry, having dwindled from nine in August to five at the present time, leave the labor cost levels in the principal cities of the country, about where they were a month ago. This applies to both skilled and un-skilled construction workers.

Compared with September, 1925 skilled building trades mechanics now get an average wage that is 4.0 per cent higher, while the rate for unskilled men has advanced 4.7 per cent. The marked similarity in percentage of increase in one year, comparing the skilled with un-skilled laborers, makes it apear as through an urgent demand for men rather than restriction of apprenticeships in the vocations requiring skill, had made the prevailing high wage levels in this industry possible. Graphs on p. 399 show wage fluctutions, this year and last.

With a volume of projected work in engineering construction, Jan. 1 to Sept. 1, 16 per cent ahead of the corresponding period in 1925, full employment of labor in this class is practically assured for the remainder of this year and a part of next.

Of the five existing building trades strikes of importance, two involve carpenters.

In San Francisco, the struggle between the carpenters unions and American or open-shop plan supporters is still in force. Violence, however seems to have subsided so far as violations of the anti-picketing ordinance are concerned. Building in general is slow but trouble with the carpenters has evidently not interfered with operations on some of the large structures.

A carpenters' strike in Syracuse, N. Y., started Nov. 1, 1925, is still in force. No definite results have been attained through negotiations entered into during the last week, by employers and the striking craftsmen.

Building trades mechanics on several large projects now under construction in Boston, are on strike in sympathy with the hoisting engineers. The latter, that is, those employed on buildings, are making an effort to include in their organization, hoisting engineers working in sand and gravel pits. In the class handling materials alone, the wage rate is much lower and the hours longer, than in the case of those engaged in building construction.

In Chicago, a group of seventy-five union men, consisting of iron workers, hoisting engineers, electrical workers and building laborers, went on strike Aug. 25, refusing to work on a Landis award project where non-union men were employed. A general spread of this movement is feared.

Chicago painters will be advanced, Sept. 13, from $1.50 to $1.62½ per hr., making them the highest paid members of this craft anywhere throughout the country. Painters in New York City get $1.50 per hr., the rate paid at present in Chicago. Bonuses are being granted in several of the trades, namely, bricklayers, structural ironworkers, lathers, plumbers, steamfitters, and plasterers. In the last mentioned craft as much as $4 per day has been paid above the regular rate of $13. Little progress has been made to date on settlement of the question of right of sympathetic strike, put forward by the organized trades.

Philadelphia painters' strike is still holding out, with active picketing on the wane. Surplus of mechanics is reported in the following trades: carpenters, painters, plumbers, steam fitters and cement finishers.

Current Building Trades Wage Rates Per Hour

(Higher rates indicated by +, decreases by —)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.12½	$0.70	$0.70	$0.50	.....	$0.75	$0.25@.30
Baltimore	1.62½@1.75	1.00@1.10	1.00@1.12½	1.00	$0.65	1.12½	.40
Birmingham	1.00@1.50	+ 60@1.05	75@1.00	50@.75	....	.75@1.75	.20@.40
Boston	1.40	1.25	1.25	.79	1.15	1.25	.50@.74
Cincinnati	1.50	1.31¼	1.31¼	.95	1.31¼	1.31¼	.45@.58
Chicago	1.62½	1.37½	1.37½	.87½	1.37½	1.37½	.82½@.87½
Cleveland	1.50	1.25	1.30	.87½@1.10	1.10	1.50	.87½
Dallas	1.62½	1.12½	1.00	.40@.75	.87½	1.00	.30@.50
Denver	1.62½	1.25	1.12½@1.18¾	.81¼@.87½	1.00	1.15⅝	.40@.55
Detroit	1.50	.90@1.15	.85@1.00	.90	.85@1.00	1.12½	.50@.60
Kansas City, Mo	1.50	1.12½	1.25	.90	1.12½	1.25	—.35@.75
Los Angeles	1.37½	1.00	1.00	.87½	.80	1.00	.50
Minneapolis	1.25	.87½@95	.87½	.75	....	+1.00	.45@.60
Montreal	+1.00@1.25	75	.60	.40	.50	.75	.30@.35
New Orleans	1.25	90	1.00	.75	.85	1.25	.35@.40
New York	1.75	1.50	1.75	1.12½	1.00@1.12½	1.75	.90⅝
Philadelphia	1.50@1.62½	1.12½@1.25	1.02½	1.12½	1.00	1.12½@1.25	.45@.50
Pittsburgh	1.62½	1.50	1.37½@1.50	1.12½	....	1.50	.80
St. Louis	1.75	1.50	1.50@1.65	1.15@1.25	1.25	1.50	.45@.75
San Francisco	1.25	1.00	1.00	.81¼	1.00	1.12½	.50@.55
Seattle	1.37½	1.12½	1.00@1.12½	1.00	1.00@1.12½	1.12½	.50@.62½

Cleveland painters, paperhangers and glaziers, who went on strike March 1, returned to work last Wednesday at the old rate of $1.25 per hr. and a five and one-half day week. The original demand of the craftsmen was for $1.37½ per hr. and a five-day week.

Comparing average wages in the New York building trades in 1920, the year of greatest general inflation, with those of the first nine months of 1926, it is found that the approximate gain to structural iron workers amounts to 41 per cent; that to hod carriers, 36 per cent; bricklayers, 29 per cent; carpenters, 27 per cent; and common laborers, 9 per cent. Plasterers' and bricklayers' rates are the same.

Monthly Prices of Construction Materials

Ups and Downs of the Market

MANUFACTURERS of construction materials in the seaboard states are facing severe competition at present, in the form of foreign steel, brick, glass and cement. Despite this situation, markets in these materials show few signs of breaking. Two cement mills in the East dropped prices 10c. per bbl., during the last month. Lumber, lime, sewer, pipe, steel sheets, tile and manila rope prices are easier than a month ago. C.-i. pipe, linseed oil, iron and steel scrap, and roofing materials appear firmer.

Pig Iron—Prices show little change from August levels, throughout the country. No. 2 fdry. iron rose 25c. in Pittsburgh and declined 50c. per ton at Cincinnati during the month. Bessemer is down $1 per ton at Pittsburgh. To all appearances, higher prices for foundry grades are improbable during the next three months.

Railway Supplies—Light rails are down about $1 per ton at Pittsburgh mills; railroad spikes dropped 10c. per 100 lb. Track bolts, angle bars and ties show firmness.

Pipe—Cast-iron pipe rose $1 in New York and $1.50 per ton at Pittsburgh, following mill advance of $1. Sewer pipe is slightly lower on sizes 10-in. to 24-in. at New York, reflecting the factory decline of a month ago. Prices hold firmly on sizes 27-in. to 36-in. Substantial advances on sizes 3-in. to 12-in. are reported in Detroit; prices at other points remain unchanged.

Road and Paving Materials—This group shows a remarkable lack of price fluctuation in the twenty-one cities reporting. Quotations are the same as those of a month ago in road oils, asphalt, paving stone, flagging, curbing, and wood blocks.

Sand, Gravel and Crushed Stone—Aggregates remain firm and unchanged at all points listed, except the following: Atlanta, where a rise of 10c. per ton occurred in sand during the month; and Detroit, which reports a decline of 15c. per ton in crushed stone.

Lime and Cement—The general tendency appears to be downward, although in sixteen cities prices remain at August levels, while Boston, Detroit and Los Angeles show declines. Mill price of portland cement declined 10c. per bbl. at New York and Pennsylvania points; no reflection of this change has appeared during the last month at dealers' warehouses. Natural cement dropped 5c. per bbl. at Kansas City, Mo.

Brick and Hollow Tile—A decline of 50c. per M. occurred in both Boston and Kansas City, Mo., during the month. Denver dealers, however, advanced prices $1 and those in Detroit marked them up $2 per M. at the same time. Hollow tile dropped slightly at Montreal, Cleveland and Detroit; in eighteen other districts prices held firmly.

Structural Steel — Quotations hold steadily with a flat rate of $2 per 100 lb. applying on 3-in. shapes and ¾-in. bars at Pittsburgh mills. Plates (¼-in.) continue at $1.90 per 100 lb., f.o.b. mill.

Lumber—Downward trend continues in material for small dwelling construction. Heavy timbers are becoming increasingly scarcer with consequent firmness in price. During the last month all of the declines occurred in fir while advances were confined to various descriptons of pine.

Linseed Oil—Prices have stiffened perceptibly during the last week. New York market is ¾c. per 7½ lb.-gal. above the August level.

Scrap—Advances in various descriptions of iron and steel scrap outnumber declines by eight to one, comparing present quotations with those of Aug. 5. This is one evidence of the stability of domestic steel prices in the face of foreign competiton and also of the recent high rate of steel production.

Miscellaneous—Rivets, nails, spikes, glass, red and white lead, pine and steel-sheet piling, and wire rope hold firmly to levels prevailng a month ago. In roofing materials advances exceed declines. Blue annealed and black steel sheets are off 5c. per 100 lb. at mills. Since Aug. 5 manila rope has dropped 1c. per lb. in Kansas City, Mo. and New York, and 3c. at San Francisco.

E. N.-R. Prices of Construction Materials

Price advances since last month are indicated by heavy ty. e; declines by italics

PIG IRON—Per Gross Ton f.o.b.:

CINCINNATI	Sept. 2	One Year Ago
No. 2 Southern (silicon 2.25@2.75)	*$24.19*	$23.05
Northern Basic	20.39	22.27
No. 2 Southern Ohio (silicon 1.75@2.25)	21.39	22.77
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25@2.75)	27.37	27.37
BIRMINGHAM		
No. 2 Foundry (silicon 2.25@2.75)	21.00	18.50
PHILADELPHIA		
Eastern Pa., No. 2X (2.25@2.75 sil.)	22.76	22.26
Virginia No. 2 (silicon 2.25@2.75)	28.67	29.17
Basic	21.26	21.16
CHICAGO		
No. 2 Foundry Local (silicon 1.75@2.25)	21.75	22.00
No. 2 Foundry Southern (silicon 2.25@2.75)	*25.05*	25.55
PITTSBURGH, including freight charge ($1.76) from the Valley		
No. 2 Foundry Valley (silicon 1.75@2.25)	19.76	20.77
Basic	19.76	20.77
Bessemer	*19.76*	20.77

SCRAP—The prices following are f.o.b. per net ton paid by dealers:

	New York*	Chicago	Birmingham
No. 1 railroad wrought	$14.75@$15.25	$13.50@$14.00	$12.00@$13.00
Stove plate	11.00@12.00	14.50@15.00	14.00@14.50
No. 1 machinery cast		16.25@16.75	16.50@17.00
Machine shop turnings	10.50@11.00	7.25@7.75	7.50@8.00
Cast borings	10.50@13.50	10.25@10.75	7.50@8.00
Railroad malleable	16.00@16.50	15.75@16.25	15.50@16.00
Re-rolling rails	14.00@14.25	15.25@15.75	15.00@16.00
Re-laying rails			21.00@22.00
Heavy melting steel	*11.00@13.75*	12.75@13.25	12.00@13.00

*Gross ton.

Railway Supplies

STEEL RAILS—The following quotations are per ton f.o.b. for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh				
	Sept. 2	One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$43.00	$43.00	$43.00	.....
Standard openhearth rails	43.00	43.00	43.00	43.00	$51.00
Light rails, 8 to 10 lb	.....	32@34	34@36	1.80@1.90*	2.05*
Light rails, 12 to 14 lb	.....	32@34	34@36	1.80@1.90*	1.88*
Light rails, 25 to 45 lb	*33@34*	32@34	34@36	1.80@1.90*	1.84*
Re-rolled rails	27@31	27@30	30.00	34@36	.....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, white oak, plain	$1.45	$1.83
Chicago, empty cell creosoted	1.90	2.45
Chicago, zinc treated	1.70	2.20
San Francisco, green Douglas fir	.84	1.14
San Francisco, empty cell creosoted, Douglas fir	1.70	2.25
St. Louis, white oak, plain	1.20	1.50
St. Louis, zinc treated	1.60	1.90
St. Louis, red oak, plain	1.10	1.40
St. Louis, sap pine-cypress	.95	1.25
Birmingham, white oak	1.25	1.45

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh mill for carload lots, together with the warehouse prices at the places named:

	Pittsburgh					
	Sept. 2	One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅝-in. and larger	$2.80@$2.90	$2.80	$3.55	$3.65	$4.35	$2.90@$3.00
Track bolts	3.90@4.25	3.90@4.15	4.55	4.40	5.85	3.90@4.15
Standard section angle bars	2.75	2.75	3.40	3.25@3.75	3.60	2.75

Pipe

WROUGHT PIPE—The following discounts are to jobbers for carload lots at Pittsburgh mill:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	62	50½	1 to 1¼	30	12
LAP WELD					
2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	1 to 1¼	30	14
2 to 3	61	50½			
LAP WELD, EXTRA STRONG, PLAIN ENDS					
2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

STEEL PIPE—From warehouses at the places named the following discounts hold for welded steel pipe:

	Black			
	New York	Chicago	Birmingham	St. Louis
1 to 3 in. butt welded	53%	54%	62%	49%
2½ to 6 in. lap welded	48%	51%	59%	46%
	Galvanized			
	New York	Chicago	Birmingham	St. Louis
1 to 3 in. butt welded	39%	41%	50½%	36%
2½ to 6 in. lap welded	35%	38%	47½%	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36 - 5% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham	Burlington, N. J.	New York Sept. 2	New York One Year Ago
4 in.	$44.00	$54.00@55.00	$56.60@57.60	$54.60@55.60
6 in. and over	40.00	50.00@51.00	52.60@53.60	50.60@51.60
	Pittsburgh	Chicago	St. Louis	San Francisco
4 in.	$52.70@54.20	$53.20@54.20	$51.50	$54.00
6 in. and over	48.70@50.20	49.20@50.20	47.50	50.00

Gas pipe and Class "A," $4 per ton extra.

CLAY DRAIN TILE—The following prices are per 1,000 lin.ft.:

Size, In.	New York Sept. 2	New York One Year Ago	St. Louis	Birmingham	San Francisco	Dallas
3	$45.00	$48.00	$40.00	$45.00	.....	$73.00
4	55.00	50.00	40.00	56.00	$76.50	110.00
5	.....	.....	.....	80.00	97.75	118.00
6	90.00	92.00	70.00	100.00	127.50	150.00
8	160.00	160.00	170.00	165.00	212.50	210.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	.....	$0.088	$0.10	.....	$0.09	$0.12	.....
4	.....	.088	.10	$0.10	.09	.15	$0.15
5	.....	.121	.135	.....	.13½	.18	.18
6	$0.24	.121	.21	.14	.13½	.21	.21
8	.43	.198	.315	.225	.21	.30	.325
10	*.50*	.231	.45	.315	.31½	.42	.476
12	*.65*	.297	.54	.405†	.40½	.56	.612
15	*1.08†*	.396	.75	.675†	.54	.92	1.02
18	*1.55†*	.55	.90	.945†	.75	1.32	1.53
20	*1.89†*	.66	1.20	.....	.90	.....	.....
21	.....	.77	.....	1.26†	.....	.....	.....
22	*2.52†*	.88	1.35	.....	1.20	.....	1.564
24	*2.84†*	.99	2.665	1.62†	1.35	2.16	2.04
27	4.65†	2.405	2.952	2.45†	2.75	3.00	3.34
30	5.16†	2.664	3.96	3.00†	3.75	3.60	4.06
33	6.98†	3.60	4.51	3.55†	4.50	.....	4.99
36	8.00†	4.10	5.06	3.95†	5.00	.....	5.42

	3	5	8	12	24	36
Boston	$0.125	$0.19	$0.28	$0.58	$2.00†	$5.50†
Minneapolis	.....	.....	.25	.45	1.50	4.56
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	.14	.....	.35	.72†	2.60†	.....
Los Angeles	.1675	.186	.2825	.504	1.74	.....
New Orleans	.116*	.277*	.295	.463	1.785	.....
Cincinnati	.105	.1575	.245	.4725	1.575	4.715
Atlanta	.10*	.15*	.25	.425	1.625	.....
Montreal	.68‡	.45†	.70	1.35	4.50†	.....
Detroit	.111	.1665	.259	.4995	1.665†	3.7925†
Baltimore	.111	.166	.259	.499	1.665	4.92
Kansas City, Mo.	.15*	.21*	.29	.52	1.90†	3.80†
Philadelphia	.11	.16	.26	.42	1.50	3.70

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

Road and Paving Materials

ROAD OILS—Following are prices per gallon in tank cars, 8,000 gal. minimum f.o.b. place named:

		Sept. 2	One Year Ago
New York, 45% asphalt	(at terminal)	$0.065@$0.07	$0.065@$0.07
New York, 65% asphalt	(at terminal)	.0675@.0725	.0675@.0725
New York, binder	(at terminal)	.07@.075	.07@.075
New York, flux	(at terminal)	.07@.075	.07@.075
New York, liquid asphalt	(at terminal)	.07@.075	.07@.075
St. Louis, 40@50% asphalt		.055	.05
St. Louis, 50@60% asphalt		.0565	.051
Birmingham, 55% asphalt		.0475	.0475
Dallas, 45% asphalt		.0495	.05
Dallas, 55% asphalt		.1455	.046
Dallas, binder		.061	.062
San Francisco, binder, per ton		12.00*	13.50*

* F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

E. N.-R. Prices of Construction Materials

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Texas*)	$23.00	$18.50
Boston (*Mexican*)	23.00	18.50
Chicago (*Texas*)	27.00	22.00
San Francisco, *f.o.b. refinery*, Oleum, Cal	18.00	12.00
Dallas (*Texas*)	27.10	21.10
Seattle, *"D" grade, California, f.o.b. Richmond*	19.50	13.50
Denver (*California*)	24.00	....
Minneapolis, *f.o.b. Twin Cities (Standard)*	27.60	21.60
St. Louis (*Mexican*)	27.00	24.00
Baltimore (*Standard Oil*) (*f.o.b. refinery*)	22.50	18.50
Montreal (*Imperial*)	27.00	22.50
Atlanta (*Mexican*)	23.40	19.40
Detroit (*Mexican*)	22.25	18.50
Cincinnati (*Kentucky Rock*)	....	11.65
Maurer, N. J. (*Bermudez*)	30.00	....
Maurer, N. J. (*Trinidad*)	23.00	....
Philadelphia (*Mexican*)	20.00	18.00
Kansas City, Mo. (*Texas*)	27.30	24.30
Los Angeles ("D" *grade, California*)	*18.00	*12.00
Birmingham (*Mexican*)	27.00	21.00
New Orleans (*Mexican*)	20.00	17.00

* F.o.b. El Segundo Refinery. Drums used in New York.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade I)	5-in. granite, 30 blocks per sq.yd.	$147.00 per M.
San Francisco	Basalt block 4x7x8	70.00 per M.
Chicago	about 5x8x5 dressed	3.60 per sq.yd.
	about 5x8x5 common	3.25 per sq.yd.
Boston	5-in. Granite	135.00 per M.
Atlanta	Granite	2.50 per sq.yd.
Detroit	5-in. Granite	3.00 per sq.yd.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	104.75 per M.
New Orleans	Granite, 4x8x4	2.75 per sq.yd.
Cincinnati	Granite	135.00 per M.
St. Louis	Granite, 4x8x4	1.65 per sq.yd.
Kansas City	Granite	3.15 per sq.yd.
Philadelphia	Granite	3.90@4.25 per sq.yd.
Minneapolis	Sandstone	2.74 per sq.yd.

FLAGGING—

New York	Bronx, 4 ft. wide	$0.24 per sq.ft.
	Manhattan, 4 ft. wide	.24 per sq.ft.
	Queens, 5 ft. wide	.26 per sq.ft.
	6x24-in. cross-walk	1.30 per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5x16 in., 88c.; *St. Louis*: Class "A" straight, delivered, 5x18 in., 91c. per lin.ft.; roundings, $1.40. *Birmingham*: Limestone, 5x18-in., $1.05 per lin.ft.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York	3	16	$2.40
New York	3½	16	2.70
Boston	3½	18	2.45
Chicago	4	16	2.25
Chicago	3½	16	2.10
St. Louis	3½	16	2.45
St. Louis	4	16	2.75
Seattle	4	16	Off market
Minneapolis	3½	16	2.40
Atlanta	3½	16	2.00
New Orleans	3	16	2.20
New Orleans	3½	16	2.30
New Orleans	4	16	2.40
Dallas	4	18	3.90
Baltimore	3½	16	None used
Montreal	4	16	4.50
Detroit	3	16	1.94
Detroit	4	16	....
Cincinnati	3	16	2.35
Kansas City	4	16	2.50
Philadelphia	4	16	None used

Construction Materials

SAND AND GRAVEL—Price for cargo or carload lots to contractor f.o.b., per cu.yd. is as follows:

	Gravel				Sand	
	1½ In.		¾ In.			
	Sept. 2	One Year Ago	Sept. 2	One Year Ago	Sept. 2	One Year Ago
New York (*alongside dock*)	$1.75	$1.75	$1.75	$1.75	$1.00	$1.00
Denver	1.90	1.90	1.90	1.90	1.00	1.00
Chicago	1.60	1.50	1.60	1.50	1.40	1.40
St. Louis	1.45	1.45	1.45	1.45	1.08	1.18
Seattle	1.50	1.50	1.50	1.50	1.50	1.50
Dallas	2.38	2.38	2.38	2.38	2.00	2.00
Minneapolis	1.65*	1.65*	1.65*	1.65*	1.25	1.25
Cincinnati	1.30†	1.40†	1.30†	1.40†	1.05†	1.35†
San Francisco	1.80	2.15	1.80	2.15	1.40	1.50
Boston	1.50†	1.50†	1.50†	1.50†	1.00†	1.00†
New Orleans	3.00	2.60	3.00	2.60	1.80	1.75
Los Angeles	1.15†	.85*†	1.15†	.85*†	1.10†	.50*†
Atlanta	1.90†	2.20†	1.90†	2.20†	1.60†	1.65†
Detroit	1.45†	2.02	1.35†	2.02	1.10†	1.62
Baltimore	1.40	1.40	1.60	1.60	.70*†	.70*†
Montreal	1.25†	1.25†	1.50†	1.25†	1.25†	1.25†
Birmingham	2.00	2.00	2.00	2.00	1.45	1.50
Philadelphia	2.10	2.10	2.10	2.10	1.50	1.50
Kansas City, Mo	4.00‡	4.00‡	4.00‡	4.00‡	.66*†	.66*†

New York—Grits, $1.75 per cu.yd.; ready mixed $1.85.
* At pit. † Per ton. ‡ Joplin chats.

CRUSHED STONE—Price for cargo or carload lots, per cu.yd. f.o.b. city, is as follows:

	1½ In.		¾ In.	
	Sept. 2	One Year Ago	Sept. 2	One Year Ago
New York	$1.75	$1.75	$1.85	$1.85
Chicago	1.70	1.75	1.87½	1.87½
St. Louis	1.83*	1.83*	1.83*	1.83*
Dallas	2.40	2.40	2.83	2.83
San Francisco	1.70	2.15	1.70	2.15
Boston	1.60*	1.60*	1.65*	1.60*
Minneapolis	1.75	1.75	1.75	1.75
Kansas City	2.00	1.50	2.00	1.50
Denver	2.50	2.50	2.50	2.50
Seattle	3.00	3.00	3.00	3.00
Atlanta	2.50*	2.20*	2.50*	2.20*
Cincinnati	1.65*	1.90*	1.65*	1.90*
Los Angeles	1.40*	1.00*	1.40*	1.00*
Detroit	1.85*	1.90	1.85*	1.90
Baltimore	2.50	2.50	2.55	2.55
Montreal	1.80*	1.80*	2.00*	1.90
Philadelphia	2.10	2.10	2.10	2.10
Pittsburgh	2.85	2.85	2.85	2.85
Cleveland	2.70*	3.25*	2.70*	3.25*
Birmingham	2.00	2.00	2.00	2.00

* Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plant

	1½-In	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.40	$2.00	$1.30
Steubenville District	1.25	1.30	2.00	1.30
Ironton District	1.40	1.40	2.00	1.40
Birmingham, Ala	.80@.90	1.15	2.05	....
Cleveland, Ohio	1.80	1.80	....	1.75
Eastern Pa. and Northern N. J.	1.25	1.25	2.50	1.25
Western Pennsylvania	1.25	1.25	2.00	1.25
Toledo, Ohio	1.25	1.25	1.50	1.25

LIME—Warehouse prices:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
New York	$18.20	$11.00	$3.50*	$2.10@3.00*
Chicago	20.00	18.00	....	2.25*
St. Louis	23.50	19.50	....	2.03*
Boston	19.00	12.50	3.65*	2.90*
Dallas	20.00	....	....	1.85†
Cincinnati	16.80	11.90	....	11.40‡
San Francisco	....	22.00	....	1.60†
Minneapolis	25.50	21.00	....	1.60@1.70†
Denver	24.00	....	....	2.70*
Detroit	16.50	11.50	....	12.00‡
Seattle, *paper sacks*	24.00	....	2.80†	....
Los Angeles	30.00	25.00	3.50*	19.00‡
Baltimore	24.25	17.85	2.55†	....
Montreal	....	21.00	....	10.00‡
Atlanta	23.50	13.00	2.20†	1.50†
New Orleans	24.00	15.00	2.50†	2.00*
Philadelphia	23.00	16.00	....	....
Kansas City	17.50	15.00	2.59†	2.24*
Birmingham	22.50	16.00	2.40†	1.85†

* Per 280-lb. bbl. (net). † Per 180-lb. (net). ‡ Per ton.

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, exclusive of bags:

	Sept. 2	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.45	1.65
Cincinnati (Utica)	1.72	1.72
Boston (Rosendale)	2.60	2.75
St. Louis (Carney)	2.35	2.35
Birmingham (Magnolia) pozzolan cement	2.40	2.40

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Sept. 2	One Month Ago	One Year Ago
New York, del. by truck	$2.50@$2.60	$2.50@$2.60	$2.50@$2.60
New York, alongside dock to dealers	2.15	2.15	2.15
Jersey City	2.33	2.33	2.33
Boston	2.30	2.30	2.45
Chicago	2.10	2.10	2.20
Pittsburgh	2.09	2.09	2.19
Cleveland	2.29	2.29	2.39
Detroit	2.15	2.15	2.35
Indianapolis	2.29	2.29	2.39
Milwaukee	2.25	2.25	2.35
Duluth	2.09	2.09	2.19
Peoria	2.27	2.27	2.37
Cedar Rapids	2.34	2.34	2.44
Davenport	2.29	2.29	2.39
St. Louis	2.20	2.20	2.30
San Francisco	2.31	2.31	2.31
New Orleans	2.30	2.30	2.40
Minneapolis	2.32	2.32	2.42
Denver	2.85	2.85	2.84
Seattle	2.65	2.65	2.65
Dallas	2.05	2.05	2.05
Atlanta	2.35	2.35	2.25
Cincinnati	2.37	2.37	2.47
Los Angeles	2.36	2.30	2.52
Baltimore	2.50	2.35	2.50
Birmingham	2.40	2.40	2.40
Kansas City, Mo	2.35	2.35	2.30
Montreal	1.15	1.15	1.80
Philadelphia	2.41	2.41	2.41
St. Paul	2.32	2.32	2.42
Toledo	2.20	2.20	2.40

NOTE—Bags 10c. each, 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind	$1.85	Hudson, N. Y	$1.95
Universal, Pa	1.85	Leeds, Ala	1.95
Steelton, Minn	1.90	Hannibal, Mo	1.95
Fordwick, Va	2.05	Lehigh Valley District	1.85
Mitchell, Ind	1.95	Wyandotte, Mich	1.90
Iola, Kan	1.85	Alpena, Mich	1.75
Mason City, Ia	1.90	Richard City, Tenn	2.05
La Salle, Ill	1.95	Kingsport, Tenn	2.05

E. N.-R. Prices of Construction Materials

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago District Mill	Warehouse: New York	St. Louis	Dallas	San Francisco
032	22	$0.97	$1.01	$1.39	$1.06	$1.13	$1.22
049	28	1.23	1.29	1.76	1.35	1.38	1.55
068	35	1.51	1.58	2.16	1.66	1.67	1.91
093	45	1.94	2.03	2.77	2.13	2.00	2.46
126	57	2.39	2.51	3.45	2.63	2.55	3.03
153	68	2.86	2.99	4.11	3.14	3.15	.....
180	78	3.28	3.43	5.70	3.60	3.47	.....
245	103	4.33	4.53	6.21	4.75	4.58	.....
287	119	5.00	5.24	7.19	5.50	5.26	6.35
336	138	5.80	6.07	8.35	6.37	6.11	.....
395	160	6.72	7.04	9.65	7.38	7.12	.....
		PAVING					
036P	17	$0.74	$0.77	$1.06	$0.81	$0.76	.....
053P	24	1.04	1.09	1.50	1.14	1.07	.....
072P	31	1.32	1.38	1.90	1.45	1.39	.....
097P	40	1.70	1.78	2.45	1.87	1.90	.....
049R	24	1.04	1.09	.....	1.14	1.07	.....
067R	31	1.32	1.38	.....	1.45	1.39	.....
089R	40	1.70	1.78	.....	1.87	1.90	.....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq.ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted:

Weight in pounds	New York	Birmingham	Chicago	St. Louis	San Francisco	Dallas
2.2	$17.00	$19.50	$17.50	$17.00	$19.00	$23.50
2.5	18.50	21.50	19.00	18.50	21.00	25.00
3.0	21.50	24.50	22.00	21.50	24.50	28.50
3.4	23.50	27.50	24.00	23.50	27.00	31.00

BARS, CONCRETE REINFORCING—Current quotations per 100 lb., in carload lots, f.o.b. except at New York and St. Louis warehouses:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse: New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger	$2.00	$2.00	$3.24	$2.60	$3.15	$2.75	$2.95
⅝	2.10	2.10	3.34	2.70	3.25	2.85	3.05
¾	2.20	2.20	3.44	2.80	3.35	2.95	3.15
⅞	2.40	2.40	3.64	3.00	3.55	3.10	3.35
1	3.00	3.00	4.24	3.60	4.15	3.75	3.95

For standard classification of extras for size and cutting of steel bars, see bar card of July 15, 1923.

ROLLED FROM RAILS

	St. Louis	Dallas		St. Louis	Dallas
½ in and larger	$2.35	$2.48	½	$2.75	$2.88
⅝	2.45	2.58	¼	3.35	3.48
¾	2.55	2.68			

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Sept. 2	Common: One Month Ago	Common: One Year Ago	Paving Block: 3-inch*	Paving Block: 3½-inch*
New York (del.)	$20.40–22.40	$20.40–22.40	$17.50–18.00	$45.00	$51.00
New York (at dock)	17.00	17.00	14.50		
Chicago	12.00	12.00	12.00	42.00	45.00
St. Louis, salmon (del.)	16.00	16.00	16.00	40.00	42.50
Denver, salmon	9@10	10@12	12.00	.....	.....
Dallas	14.10	14.10	11.60	35.00	.....
San Francisco	15.00	15.00	15.50	.....	.....
Los Angeles	10.00	9.00	11.50	(not used)	
Boston (del.)	19.00	18.50	18.00	45.00	50.00
Minneapolis (del.)	13.75	13.75	13.50	.....	.....
Kansas City	14.00	13.50	16.50	(no market)	
Seattle	15.00	15.00	15.00	.....	42.50
Cincinnati	15.50	15.50	17.00	40.00	45.00
Montreal	20.25	17.50	17.50	100.00†	68.00
Detroit (del.)	14.00	16.00	16.00	38.40	41.50
Baltimore	18.00	18.00	17.00	40.00	45.00
Atlanta	10.50	10.50	10.50	40.00	.....
New Orleans	15.00	15.00	15.00	.....	50.00
Birmingham	14.50	14.50	12.50	40.00	45.00
Philadelphia	19.00	19.00	19.00	40.00	50.00
Pittsburgh (del.)	16.00	16.00	16.00	.....	.....
Cleveland	12@14	12@14	14.00	.....	.....

*For paving blocks 3x8½x4 and 3½x8½x4 respectively. †Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Sept. 2 on Trucks*†	New York: One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco†	Perth Amboy N. J., Factory*
4x12x12	$0.1112	$0.1162	$0.075	$0.105	$0.07	$0.108	.....
6x12x12	.1667	.1743	.096	.....	.094	.156	.....
8x12x12	.2084	.2179	.135	.205	.128	.244	.....
10x12x12	.....	.....	.167	.....	.16	.....	$0.252
12x12x12	.....	.....	.215	.....	.19	.....	.312

*5 per cent off for cash. †Partition tile.

	4x12x12	8x12x12	12x12x12
Boston	$0.085	$0.175	$0.30
Minneapolis (f.o.b. cars)	.068	.1175	.205
Minneapolis (delivered)	.076	.13	.225
Cincinnati	.064	.1295	.1726
Kansas City	.088	.158	.242
Denver	.075	.155	.188
Seattle (delivered)	.09	.18	.26
Los Angeles	.085	.172	.....
New Orleans	.13	.20	.35
Detroit (delivered)	.0884	.1592	.....
Montreal	.10	....	.....
Baltimore	.124	.268	.....
Atlanta	.0895	.1837	.....
Dallas	.112	.19	.31
Birmingham	.11	.124	....
Pittsburgh (delivered)	.068	.128	.179
Cleveland	.062	.12	.....

STRUCTURAL MATERIAL—Following are base prices per 100 lb. in carload lots, f.o.b. mill, Pittsburgh and Birmingham, together with quotations in less-than-carload lots from warehouses at places named:

	Pittsburgh Mill	Birmingham	Warehouse: New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$2.00	$2.00	$3.34	$4.15	$3.25	$3.10	$3.30
Channels, 3 to 15 in.	2.00	2.00	3.34	4.15	3.25	3.10	3.30
Angles, 3 to 16 in., ¼ in. thick	2.00	2.00	3.34	4.15	3.25	3.10	3.30
Tees, 3 in. and larger	2.00	2.00	3.34	4.15	3.35	3.10	3.30
Plates, ¼ in. thick and heavier	1.90	2.00	3.34	4.15	3.25	3.10	3.30

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	New York: Sept. 2	New York: One Yr. Ago	Warehouse: Chicago	St. Louis	San Francisco	Dallas
½ in.	$2.50@2.60	$4.20	$4.50	$3.50	$3.65	$5.00	$4.75
CONE HEAD BOILER							
½ in.	2.90	$4.40	$4.70	$3.70	$3.85	$5.20	$5.00
⅝ and ¾	3.05	4.55	4.85	3.80	4.20@4.45	5.35	5.15
½ and ⅞	3.30	4.80	5.10	4.05	4.60	5.60	5.50

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Birmingham	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.65	$2.65	$3.05	$3.75	$4.25	$2.93	$4.95
Cut	2.80	2.80	.....	5.00	5.00	3.15	5.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco: Galv.	San Francisco: Black	Seattle Black
½	$7.50	$5.75	$7.75
⅝	7.05	5.30	5.65
¾	6.90	5.15	5.50

Pittsburgh base in lots of 200 kegs or more, $3.25.

PREPARED ROOFINGS—Slate-surfaced roofing in rolls of 108 sq.ft. costs *$2.31* per roll to contractors in carload lots f.o.b. New York.

Single shingles, slate finish, cost *$6.49* per square (sufficient to cover 100 sq.ft.) in carload lots, f.o.b. New York. Strip shingles (4 in 1) f.o.b. New York, in carload lots to contractors, **$5.09** per square.

ROOFING MATERIALS—Prices f.o.b. New York, to contractors in carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton	**$72 80**
Asphalt coating per bbl.	17 00
Asphalt felt, per ton	**74 20**

WINDOW GLASS—United inches, 25, bracket size 6x8 to 10x15, single thickness "AA," 83 per cent; "A," 87 per cent; "B," 89 per cent. Double thickness "AA," 82 per cent; "A," 86 per cent; "B," 89 per cent discount from jobbers list at New York warehouses.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	*$2.25@2.30*	$3.60	$3.50	$3.90	$3.89
No. 12	*2.30@2.35*	3.65	3.55	3.95	3.94
No. 14	*2.35@2.40*	3.70	3.60	4.00	3.99
No. 16	*2.45@2.50*	3.80	3.70	4.10	4.09
Black					
*Nos. 18 to 20	*2.90@* 2.95	4.40	3.90	4.70	4.30
*Nos. 22 to 24	*2.95@* 3.00	4.45	3.95	4.75	4.35
*Nos. 26 and 27	*3.00@* 3.05	4.50	4.00	4.80	4.40
*No. 28	*3.10@* 3.15	4.60	4.10	4.90	4.50
Galvanized					
No. 10	3.20@3.30	4.70	4.25	5.00	4.65
Nos. 12 to 14	3.30@3.40	4.80	4.35	5.10	4.75
No. 16	3.45@3.55	.....	4.50	5.25	4.90
Nos. 18 to 20	3.60@3.70	5.10	4.65	5.40	5.05
Nos. 22 to 24	3.75@3.85	5.25	4.80	5.55	5.20
*Nos. 26 and 27	3.90@4.00	5.40	4.95	5.70	5.35
*No. 28	4.20@4.30	5.70	5.25	6.00	5.65

* For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per 7½-lb. gallon:

	New York: Sept. 2	New York: One Year Ago	Chicago: Sept. 2	Chicago: One Year Ago
Raw in barrels (5 bbl. lots)	**$0.95½**	**$1.08**	*$0.92*	**$1.08**

E. N.-R. Prices of Construction Materials

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b. New York:

	Dry		In Oil	
	Sept. 2	1 Yr. Ago	Sept 2	1 Yr. Ago
Red	$15.25	$15.75	$16.75	$17.25
White	15.25	15.75	15.25	15.75

Lumber

Prices wholesale, per M. ft. b.m., to contractors in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to contractors at yards.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$26.00	$27.00	$28.00	$31.00
3x6 and 8	26.00	27.00	28.00	31.00
4x4-6 and 8	26.00	27.00	28.00	31.00
3x10 and 12	26.00	27.00	28.00	31.00
3x14	30.00	30.00	32.00	34.00
4x10 and 12	26.00	27.00	28.00	31.00
4x14	30.00	30.00	32.00	34.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$28.00	$30.00	$32.00
6x14	34.00	36.00	38.00
8x10	28.00	30.00	32.00
8x14	34.00	36.00	38.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York		Chicago	
	20 Ft. and Under L.L.Y.P.	22-24 Ft. L.L.Y.P.	20 Ft. and Under No. 1 L.L.Y.P.	Up to 32 Ft. No. 1 Douglas Fir
3x4 to 8x8	$43.00	$44.00	$41.50	$40.50
3x10 to 10x10	50.00	51.00	47.50	40.50
3x12 to 12x12	57.00	58.00	57.50	40.50
3x14 to 14x14	65.00	66.00	....	40.50
3x16 to 16x16	77.00	78.00	....	42.00

New York—Wholesale price of long-leaf pine (merchantable) to dealers; to contractors, delivered from lighters or cars to job, $5@$10 additional. Short-leaf pine costs $3 per M. ft. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 32 ft. and $1 for each additional foot from 32 to 36 ft.

Other Cities

	8x8-In. x 20 Ft. and Under				12x12-In. 20 Ft. and Under	
	P.	Fir*	Hemlock	Spruce	P.	Fir*
Boston	$50.00	$48.00†	$50.00	$50.00	$60.00	$57.50†
Seattle	....	24.00	....	....	....	23.00
New Orleans	35.00	....	....	....	43.00	....
Baltimore	32.50	49.25	53.00	60.00	38.00	49.75
Cincinnati	37.00	73.00	73.00	85.00	48.00	77.00
Montreal	50.00	58.00	....	....	60.00	65.00
Los Angeles	....	*33.00*	....	....	....	*33.00*
Denver	....	36.25	34.75	34.75	....	34.75
Minneapolis	**42.50**	38.25	34.50	.....	**45.00**	*38.25*
Atlanta	31.00	....	.....	.....	34.00	....
Dallas	56.00	....	.....	.....	56.00	....
Kansas City, Mo.	44.50	42.75	.....	.....	59.50	42.75
Birmingham	35.00	....	.....	.....	40.00	....
Philadelphia	54.00	36.00	38.00	45.00	65.00	36.00
Detroit	47.75	46.75	.....	.....	61.75	46.75
St. Louis	41.00	....	.....	.....	53.00	....

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir*	Hemlock	P.	Fir*
Boston	$46.00	$42.00†	$45.00	$50.00	$48.00†
Seattle	....	22.00	.....	....	24.00
New Orleans	72.50	....	.....	45.00	....
Baltimore	55.00	44.00	44.00	34.00	50.00
Cincinnati	70.00	79.00	75.00	38.00	85.00
Montreal	45.00	50.00	40.00	65.00	50.00
Los Angeles	.....	*27.00*	.....	36.00	....
Denver	....	33.25	33.25	....	31.25
Minneapolis	42.50	36.25	34.75	**36.00**	34.25
Atlanta	22.00	.....	.....	28.00	.....
Dallas	52.25	.....	.....	56.00	.....
Kansas City, Mo.	53.75	43.75	40.75	48.00	42.75
Birmingham	30.00	.....	.....	45@48	....
Philadelphia	30.00	36.00	36.00	52.00	35.00
Detroit	39.75	37.00	.....	46.50	41.25
St. Louis	42.00	.....	.....	29.50	.....

Birmingham—Quotes carload lots, f.o.b. sidings; $4.00 additional per M. ft. to contractors.
Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.
Denver—Quotes dealers price to contractors on large projects.
St. Louis—Wholesale price to contractors, f.o.b. cars, $2 per M.ft. additional.
Seattle—Price to contractors, delivered.
Dallas—Wholesale to contractors, $10 per M.ft. additional.
*Douglas fir. †Prime.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York:

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

Miscellaneous

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

Sept. 2	One Month Ago	One Year Ago
$2.25@$2.30	$2.25@$2.30	$2.25@$2.30

CONCRETE MASONRY UNITS—Standard 8x8x16-in., delivered to job, each:

Denver	$0.22	St. Louis	$0.18*
Detroit	.16	Boston	.22
New Orleans	.23	Minneapolis	.18*
New York (Brooklyn)	.18@.20	Philadelphia	.18@.26*
Pittsburgh	.16	*F.o.b.	

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington: Discount 5 points less than discount for Eastern territory.
Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.
Arizona: Discount 10 points less than discount for Eastern territory.
Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.
North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ⅜-in., 8 ft.; ½-in., 6; ⅝-in., 4½; ¾-in., 3½; 1¼-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0.21	New Orleans	$0.23½
New York	.24	Los Angeles	.25
Chicago	.22½	Seattle	.24
Minneapolis	.24½	St. Louis	.24½
San Francisco	.22	Montreal	.17
Atlanta	.27	Detroit	.24½
Denver	.24@.25	Baltimore	.18
Cincinnati	.21	Kansas City	.27
Dallas	.31	Birmingham	.26@.27
Philadelphia	.25		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.265*	$0.2875*
Boston	.23	.25
Kansas City	.2025	.22
Seattle	.165	.19
Chicago	.195†	.2175†
Minneapolis	.1917	.2123
St. Louis	.22	.245
Denver	.2025	.2275
Dallas	.225	.302
Los Angeles	.1875	.2225
Atlanta	**.23**	**.255**
Baltimore	.22	.23
Cincinnati	.22	.245
Montreal	*.1675*	*.1895*
Birmingham	.22	.24
New Orleans	**.233**	.26
San Francisco	.1625	.1922
Philadelphia	.215	.24

* Special gelatin. †Quantities above 500. lb. and less than a ton.

CHEMICALS—Water and sewage treatment chemicals, spot shipments in carload lots, f.o.b. works:

Sulphate of aluminum, in bags, per 100 lb	$2.00@$2.10
Sulphate of copper, in bbl., per 100 lb	**4.90**@5.00
Soda ash, 58%, in bags, per 100 lb	1.38
Chlorine, liquid, tanks, per lb	.04@.04½
Hypochlorite of lime (bleaching powder) in drums, per 100 lb	2.00@2.10

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Atlanta	$0.58	Detroit	$0.29
Baltimore	.31	Kansas City	.735
Birmingham	.58	New Orleans	.67
Boston	.365	New York	.34
Buffalo	.265	Pacific Coast (all rail)	1.15*
Chicago	.34	Philadelphia	.32
Cincinnati	.29	St. Louis	.43
Cleveland	.19	St. Paul	.60
Denver	1.15*		

* Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.